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(54) **WIRELESS INTERNET PRODUCT SYSTEM**

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(60) Provisional application No. 61/074,484, filed on Jun. 20, 2008.

(51) **Int. Cl.**

G06F 15/173	(2006.01)
H04L 29/06	(2006.01)
H04L 29/12	(2006.01)
H04L 29/08	(2006.01)

(52) **U.S. Cl.**
CPC ***H04L 63/029*** (2013.01); ***H04L 61/103*** (2013.01); ***H04L 61/2514*** (2013.01); ***H04L 61/2589*** (2013.01); ***H04L 63/0281*** (2013.01); ***H04L 67/02*** (2013.01); ***H04L 67/10*** (2013.01); ***H04L 67/2823*** (2013.01); ***H04L 69/08*** (2013.01); *H04L 63/08* (2013.01); *H04L 67/12* (2013.01)

(58) **Field of Classification Search**
CPC ... H04L 63/0281; H04L 63/08; H04L 63/029; H04L 69/08; H04L 67/02; H04L 67/2823; H04L 61/2514; H04L 61/103; H04L 61/2589
USPC 709/225, 238, 231, 228, 219, 217; 370/352, 401, 252; 455/466, 557
See application file for complete search history.

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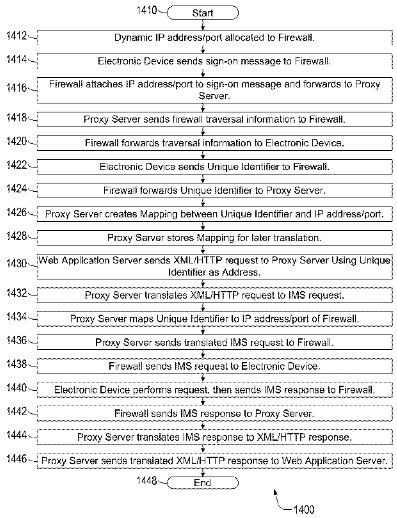
Primary Examiner — Thuong Nguyen

(74) *Attorney, Agent, or Firm* — The Mueller Law Office, P.C.

(57) **ABSTRACT**

Low resource internet devices such as consumer electronics products connect to web service by means of a proxy method where the connected device does not need to maintain the expensive and fragile web service interface itself, but rather uses simple low level protocols to communicate through a gateway that executes software to translate a low level proprietary wireless protocol to a proprietary low level internet protocol that can pass through a firewall to proxy servers that translate the low level protocols thus presenting an interface that makes the internet device appear to have a full web service interface to enable communication between the internet devices and the web server.

20 Claims, 9 Drawing Sheets


1410
Start
1412
Dynamic IP address/port allocated to Firewall.
1414
Electronic Device sends sign-on message to Firewall.
1416
Firewall attaches IP address/port to sign-on message and forwards to Proxy Server.
1418
Proxy Server sends firewall traversal information to Firewall.
1420
Firewall forwards traversal information to Electronic Device.
1422
Electronic Device sends Unique Identifier to Firewall.
1424
Firewall forwards Unique Identifier to Proxy Server.
1426
Proxy Server creates Mapping between Unique Identifier and IP address/port.
1428
Proxy Server stores Mapping for later translation.
1430
Web Application Server sends XML/HTTP request to Proxy Server Using Unique Identifier as Address.
1432
Proxy Server translates XML/HTTP request to IMS request.
1434
Proxy Server maps Unique Identifier to IP address/port of Firewall.
1436
Proxy Server sends translated IMS request to Firewall.
1438
Firewall sends IMS request to Electronic Device.
1440
Electronic Device performs request, then sends IMS response to Firewall.
1442
Firewall sends IMS response to Proxy Server.
1444
Proxy Server translates IMS response to XML/HTTP response.
1446
Proxy Server sends translated XML/HTTP response to Web Application Server.
1448
End
1400

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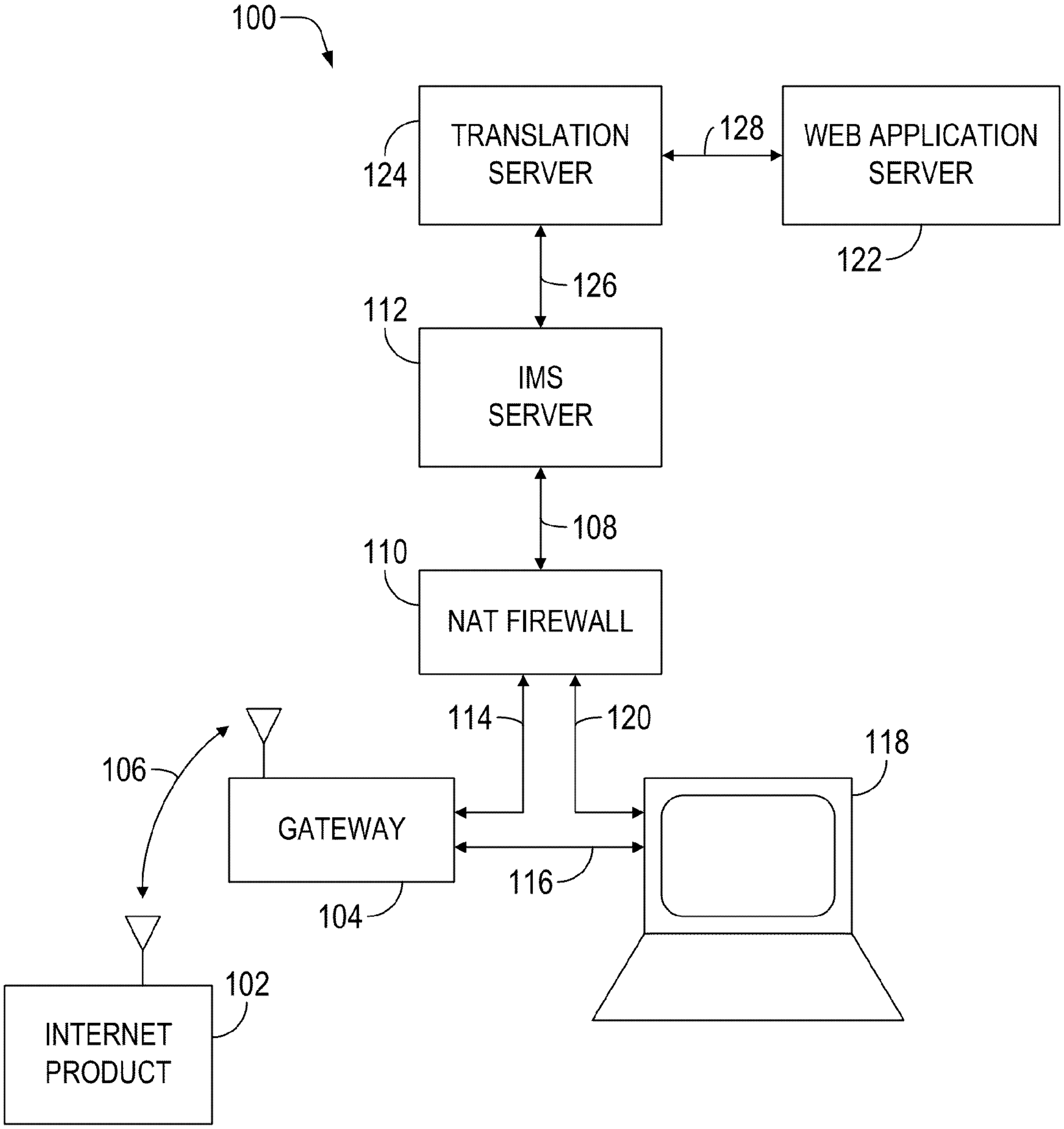

100
TRANSLATION SERVER
124
128
WEB APPLICATION SERVER
122
126
112
IMS SERVER
108
110
NAT FIREWALL
114
120
118
106
GATEWAY
116
104
102
INTERNET PRODUCT

FIG. 1

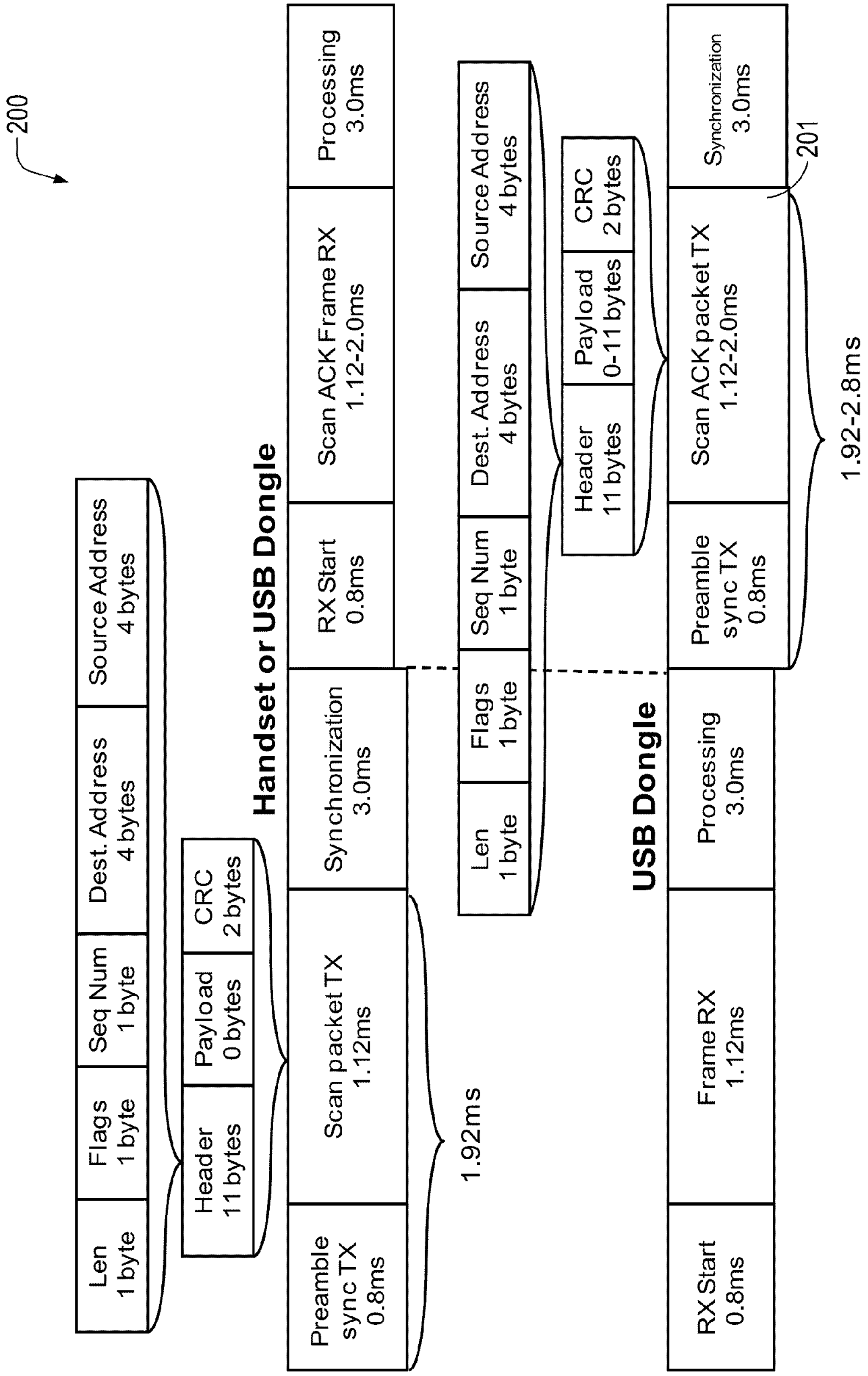

200
Len 1 byte
Flags 1 byte
Seq Num 1 byte
Dest. Address 4 bytes
Source Address 4 bytes
Header 11 bytes
Payload 0 bytes
CRC 2 bytes
Handset or USB Dongle
Preamble sync TX 0.8ms
Scan packet TX 1.12ms
Synchronization 3.0ms
RX Start 0.8ms
Scan ACK Frame RX 1.12-2.0ms
Processing 3.0ms
1.92ms
Len 1 byte
Flags 1 byte
Seq Num 1 byte
Dest. Address 4 bytes
Source Address 4 bytes
Header 11 bytes
Payload 0-11 bytes
CRC 2 bytes
USB Dongle
RX Start 0.8ms
Frame RX 1.12ms
Processing 3.0ms
Preamble sync TX 0.8ms
Scan ACK packet TX 1.12-2.0ms
Synchronization 3.0ms
201
1.92-2.8ms

FIG. 2

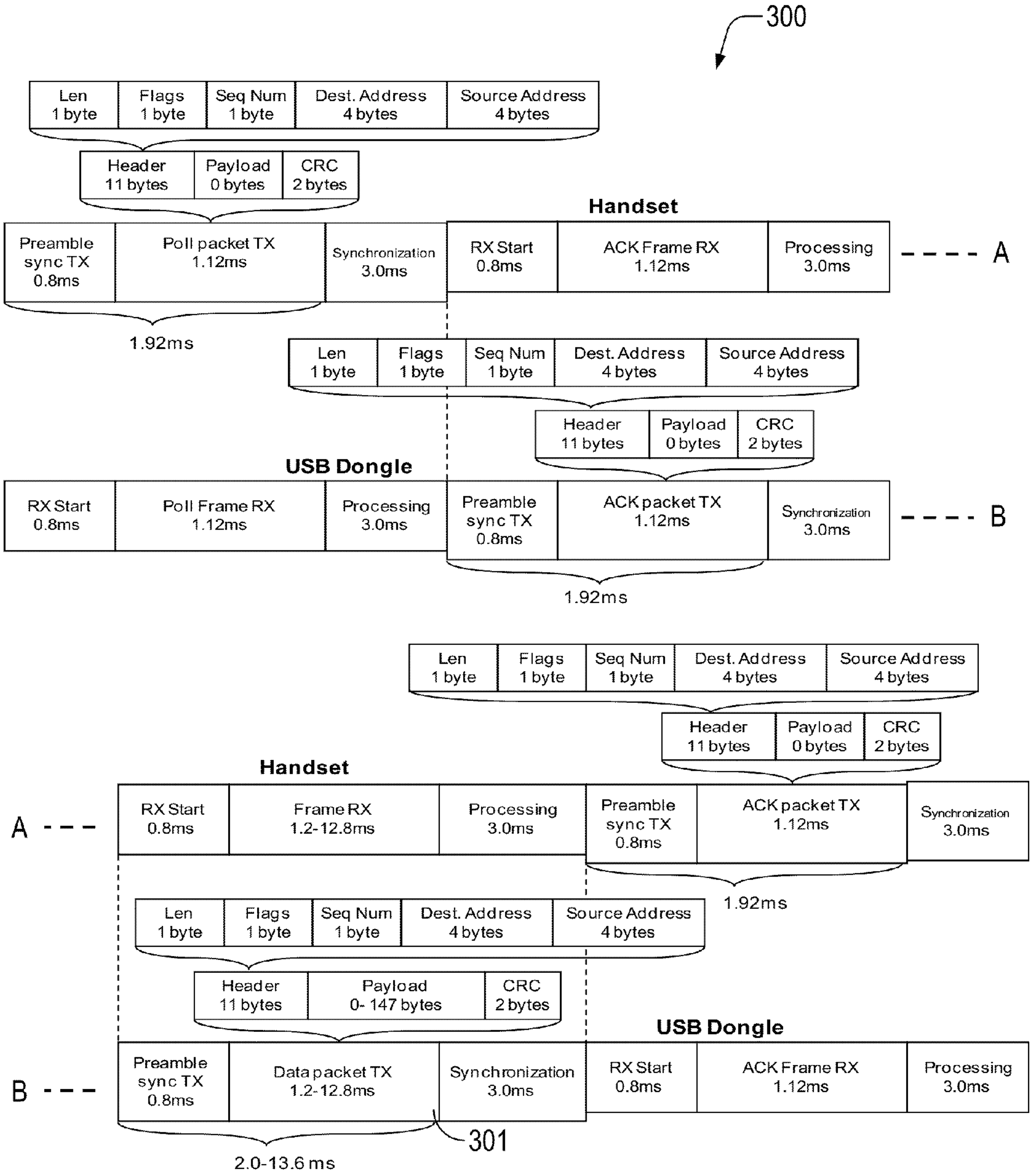
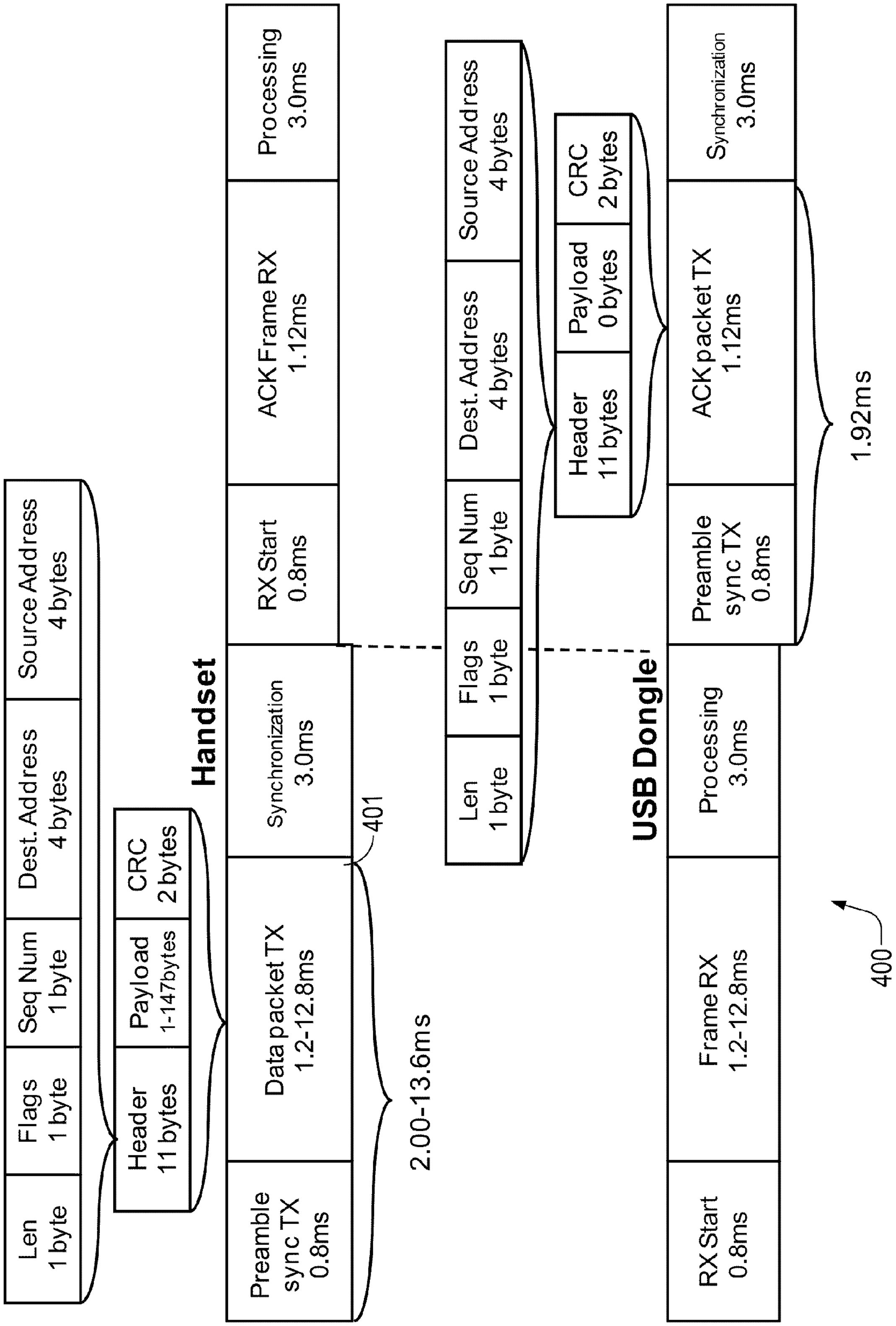

300
Len 1 byte
Flags 1 byte
Seq Num 1 byte
Dest. Address 4 bytes
Source Address 4 bytes
Header 11 bytes
Payload 0 bytes
CRC 2 bytes
Handset
Preamble sync TX 0.8ms
Poll packet TX 1.12ms
Synchronization 3.0ms
RX Start 0.8ms
ACK Frame RX 1.12ms
Processing 3.0ms
A
1.92ms
Len 1 byte
Flags 1 byte
Seq Num 1 byte
Dest. Address 4 bytes
Source Address 4 bytes
Header 11 bytes
Payload 0 bytes
CRC 2 bytes
USB Dongle
RX Start 0.8ms
Poll Frame RX 1.12ms
Processing 3.0ms
Preamble sync TX 0.8ms
ACK packet TX 1.12ms
Synchronization 3.0ms
B
1.92ms
Len 1 byte
Flags 1 byte
Seq Num 1 byte
Dest. Address 4 bytes
Source Address 4 bytes
Header 11 bytes
Payload 0 bytes
CRC 2 bytes
Handset
A
RX Start 0.8ms
Frame RX 1.2-12.8ms
Processing 3.0ms
Preamble sync TX 0.8ms
ACK packet TX 1.12ms
Synchronization 3.0ms
1.92ms
Len 1 byte
Flags 1 byte
Seq Num 1 byte
Dest. Address 4 bytes
Source Address 4 bytes
Header 11 bytes
Payload 0- 147 bytes
CRC 2 bytes
USB Dongle
B
Preamble sync TX 0.8ms
Data packet TX 1.2-12.8ms
Synchronization 3.0ms
RX Start 0.8ms
ACK Frame RX 1.12ms
Processing 3.0ms
301
2.0-13.6 ms

FIG. 3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Flags 1 byte
Seq Num 1 byte
Dest. Address 4 bytes
Source Address 4 bytes
Header 11 bytes
Payload 1-147bytes
CRC 2 bytes
Handset
Preamble sync TX 0.8ms
Data packet TX 1.2-12.8ms
Synchronization 3.0ms
RX Start 0.8ms
ACK Frame RX 1.12ms
Processing 3.0ms
401
2.00-13.6ms
Len 1 byte
Flags 1 byte
Seq Num 1 byte
Dest. Address 4 bytes
Source Address 4 bytes
Header 11 bytes
Payload 0 bytes
CRC 2 bytes
USB Dongle
RX Start 0.8ms
Frame RX 1.2-12.8ms
Processing 3.0ms
Preamble sync TX 0.8ms
ACK packet TX 1.12ms
Synchronization 3.0ms
1.92ms
400

FIG. 4

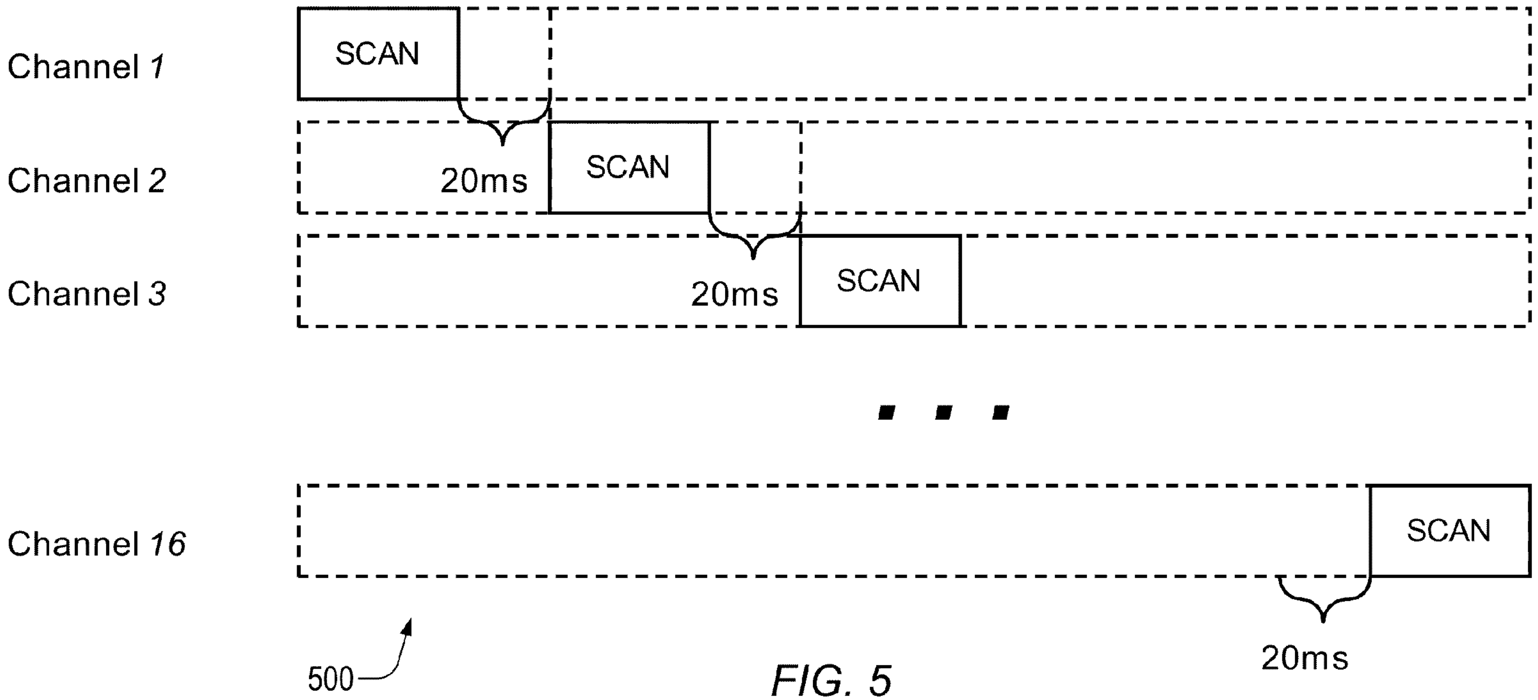
Channel 1
SCAN
20ms
Channel 2
SCAN
20ms
Channel 3
SCAN
Channel 16
SCAN
20ms
500

FIG. 5

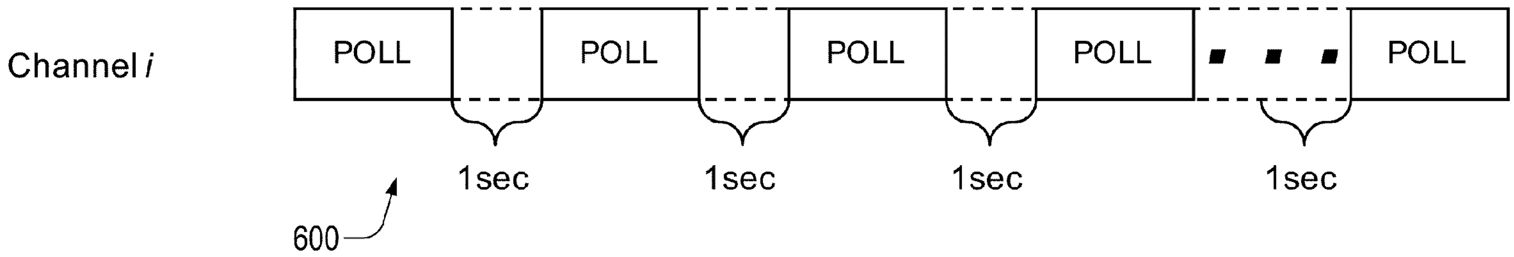
Channel i
POLL
POLL
POLL
POLL
POLL
1sec
1sec
1sec
1sec
600

FIG. 6

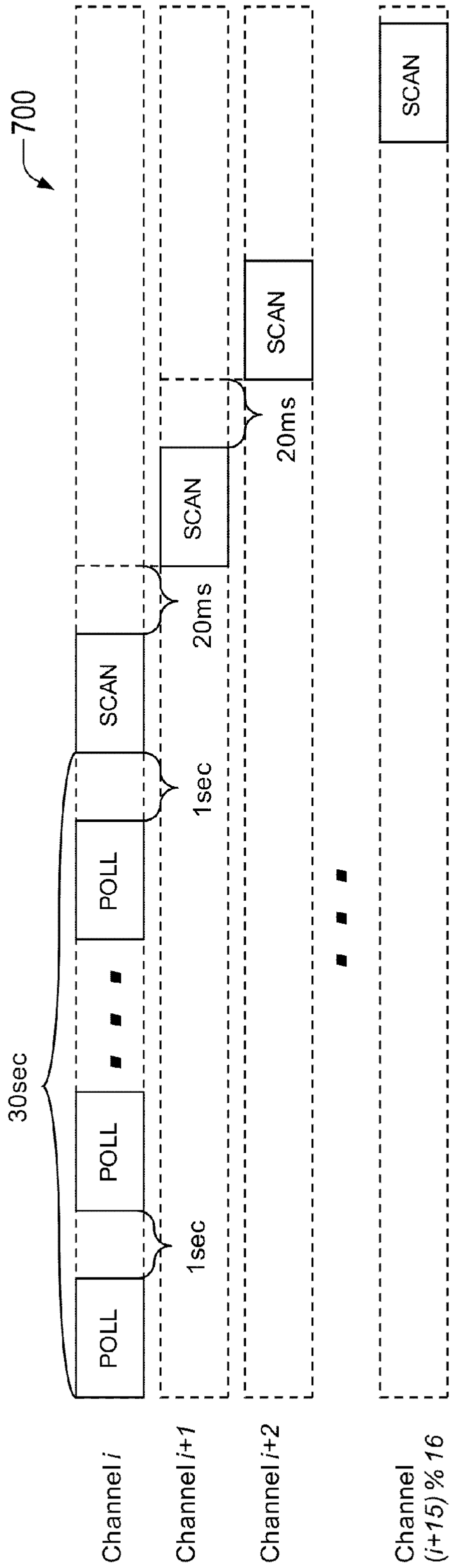

FIG. 7

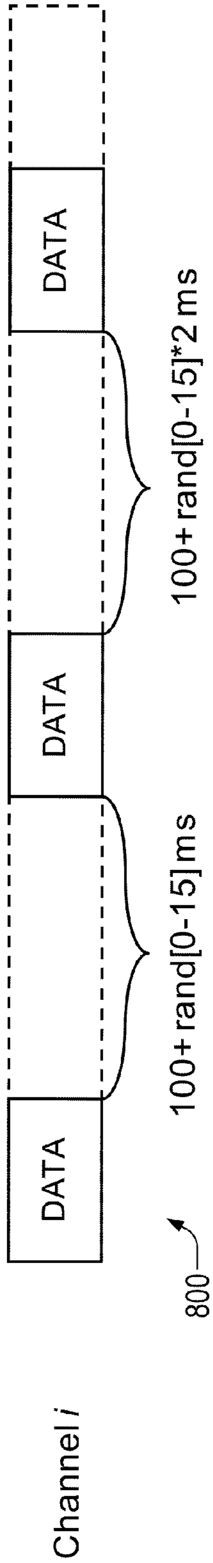

FIG. 8

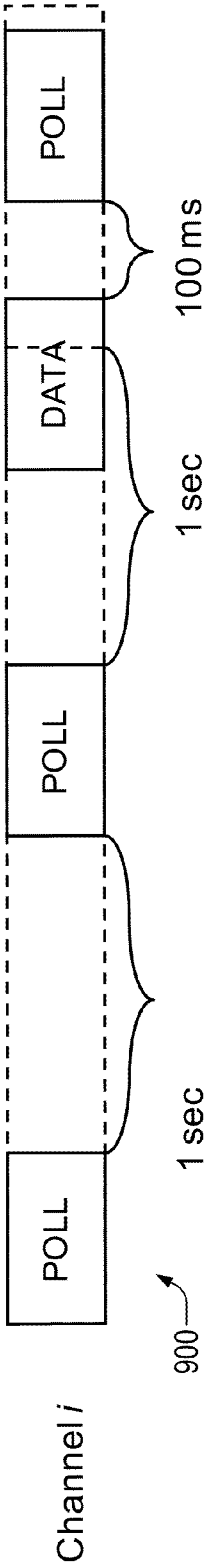

FIG. 9

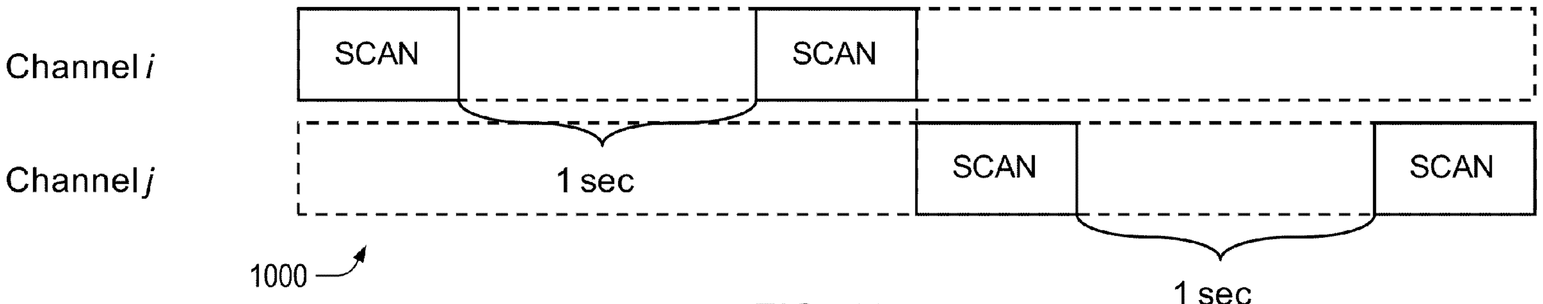
Channel *i*
Channel *j*
SCAN
SCAN
SCAN
SCAN
1 sec
1 sec
1000

FIG. 10

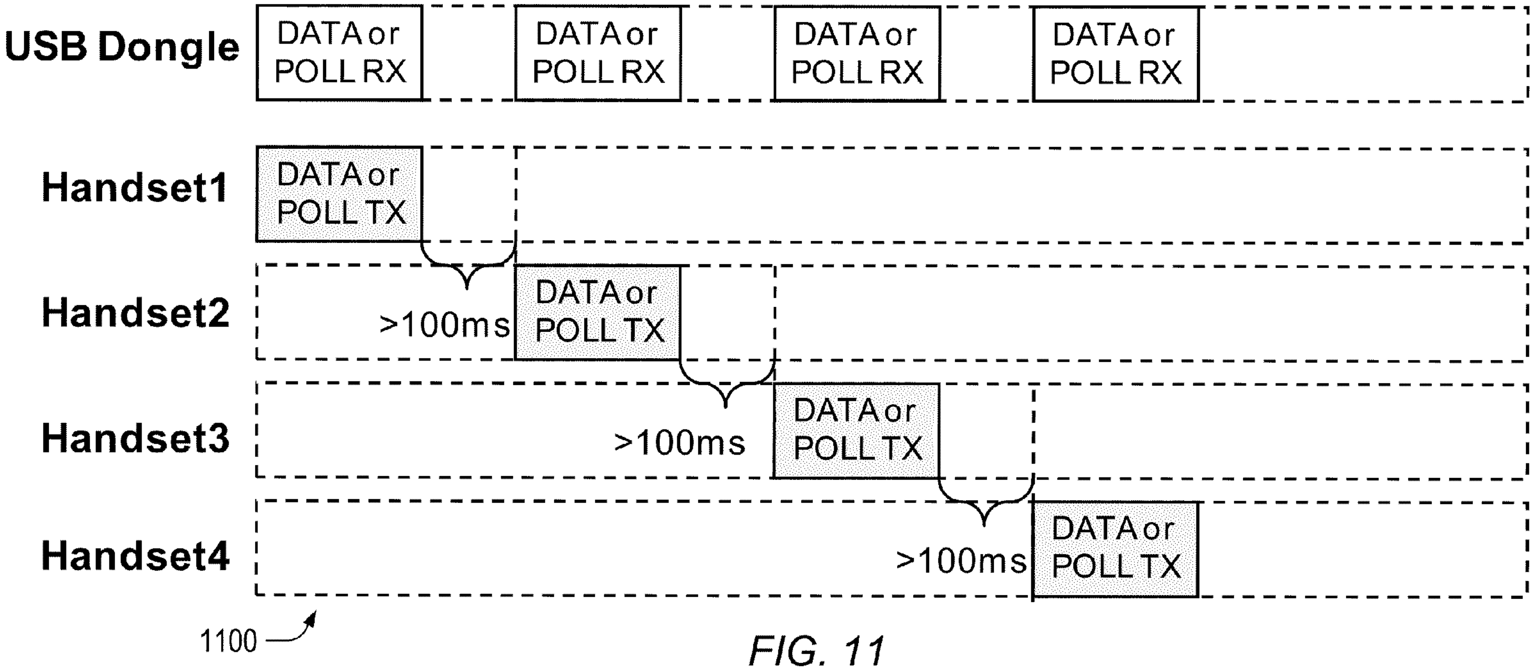
USB Dongle
Handset1
Handset2
Handset3
Handset4
DATA or POLL RX
DATA or POLL RX
DATA or POLL RX
DATA or POLL RX
DATA or POLL TX
DATA or POLL TX
DATA or POLL TX
DATA or POLL TX
>100ms
>100ms
>100ms
1100

FIG. 11

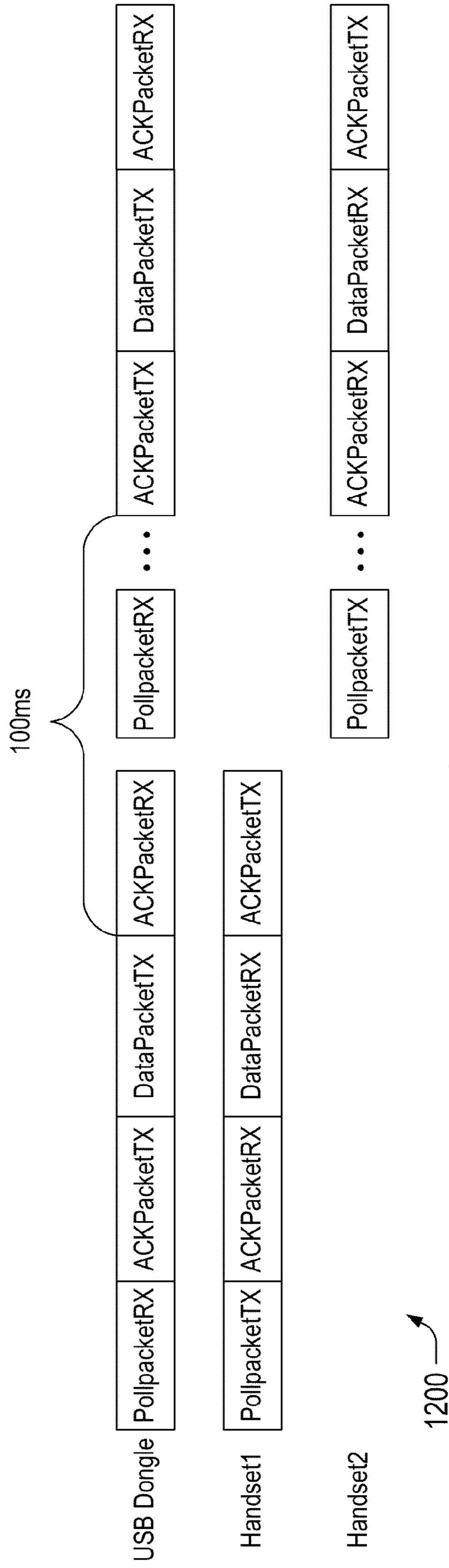
USB Dongle
PollpacketRX
ACKPacketTX
DataPacketTX
ACKPacketRX
PollpacketRX
• • •
ACKPacketTX
DataPacketTX
ACKPacketRX
100ms
Handset1
PollpacketTX
ACKPacketRX
DataPacketRX
ACKPacketTX
Handset2
PollpacketTX
• • •
ACKPacketRX
DataPacketRX
ACKPacketTX
1200

FIG. 12

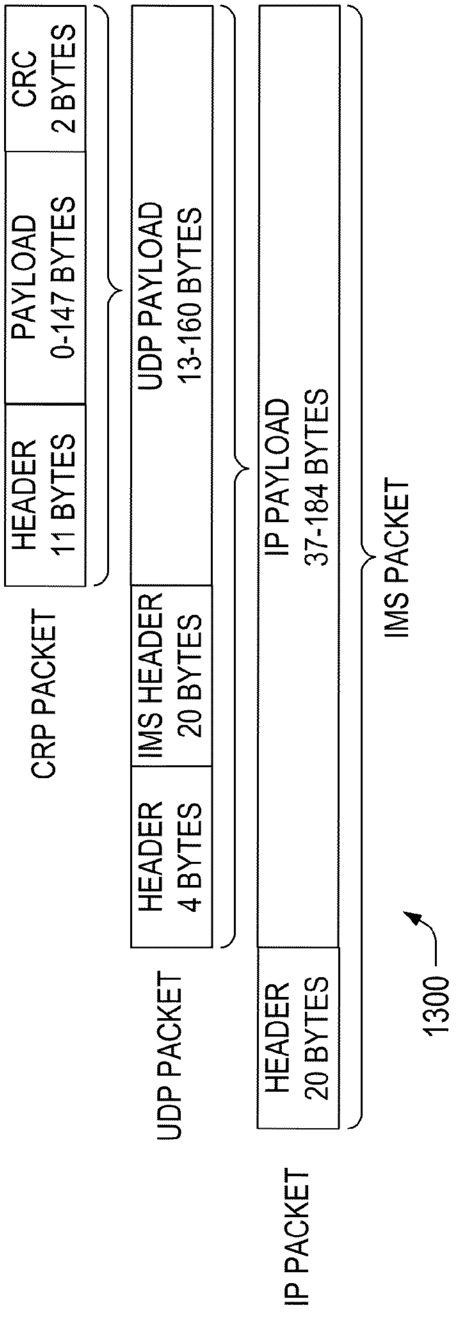
CRP PACKET
HEADER
11 BYTES
PAYLOAD
0-147 BYTES
CRC
2 BYTES
UDP PACKET
HEADER
4 BYTES
IMS HEADER
20 BYTES
UDP PAYLOAD
13-160 BYTES
IP PACKET
HEADER
20 BYTES
IP PAYLOAD
37-184 BYTES
IMS PACKET
1300

FIG. 13

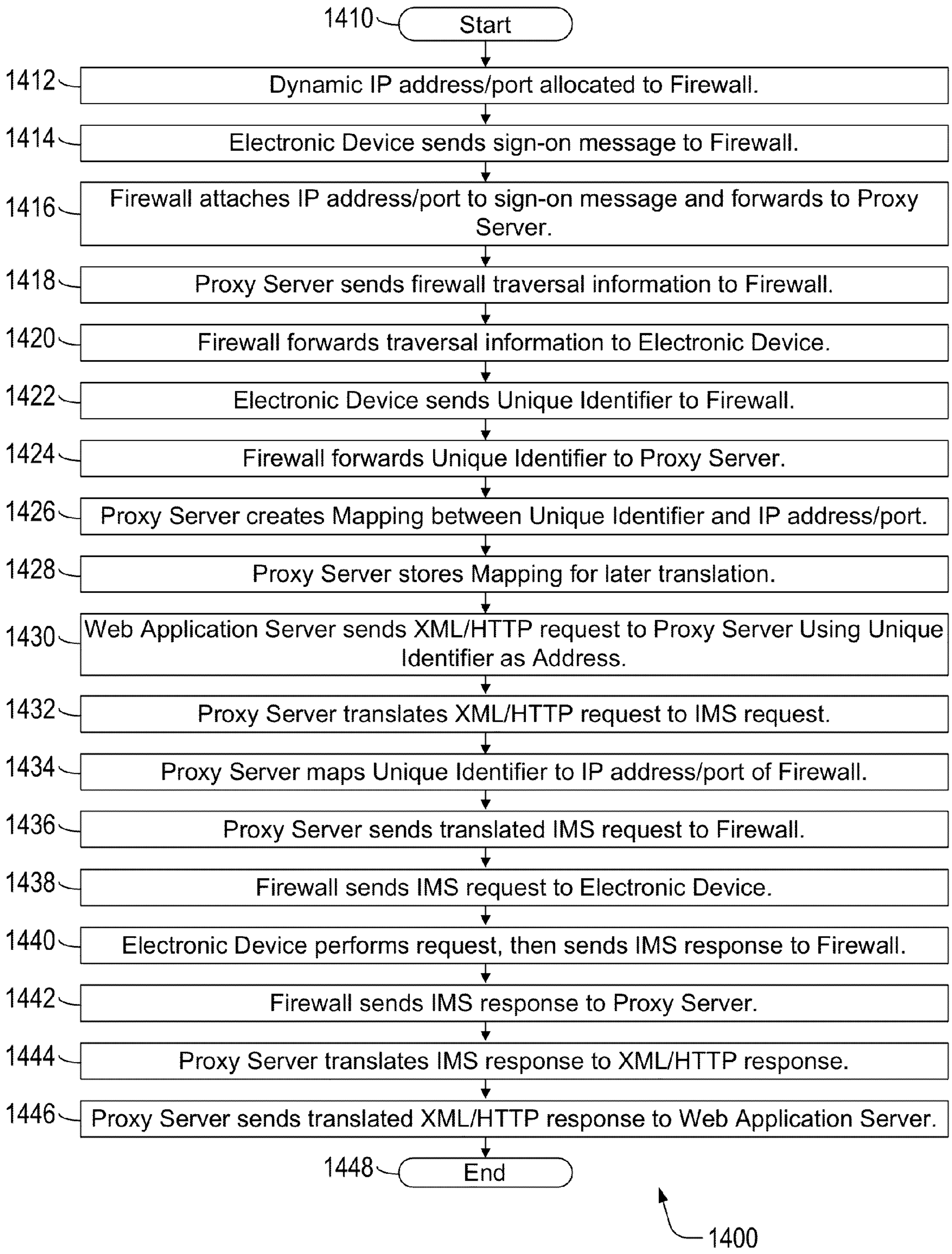
1410
Start
1412
Dynamic IP address/port allocated to Firewall.
1414
Electronic Device sends sign-on message to Firewall.
1416
Firewall attaches IP address/port to sign-on message and forwards to Proxy Server.
1418
Proxy Server sends firewall traversal information to Firewall.
1420
Firewall forwards traversal information to Electronic Device.
1422
Electronic Device sends Unique Identifier to Firewall.
1424
Firewall forwards Unique Identifier to Proxy Server.
1426
Proxy Server creates Mapping between Unique Identifier and IP address/port.
1428
Proxy Server stores Mapping for later translation.
1430
Web Application Server sends XML/HTTP request to Proxy Server Using Unique Identifier as Address.
1432
Proxy Server translates XML/HTTP request to IMS request.
1434
Proxy Server maps Unique Identifier to IP address/port of Firewall.
1436
Proxy Server sends translated IMS request to Firewall.
1438
Firewall sends IMS request to Electronic Device.
1440
Electronic Device performs request, then sends IMS response to Firewall.
1442
Firewall sends IMS response to Proxy Server.
1444
Proxy Server translates IMS response to XML/HTTP response.
1446
Proxy Server sends translated XML/HTTP response to Web Application Server.
1448
End
1400

FIG. 14

WIRELESS INTERNET PRODUCT SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to U.S. patent application Ser. No. 12/489,154 filed Jun. 22, 2009, and entitled "Wireless Internet Product System"; which claims priority to U.S. Provisional Patent Application No. 61/074,484 filed Jun. 20, 2008, both of which are hereby incorporated by reference for all purposes.

BACKGROUND

1. Field of the Invention

Invention relates to networked communication systems, particularly to systems enabling simple electronic devices having web service connectivity.

2. Related Art

It is desirable to create a wireless internet system to connect products that can communicate with each other and web applications. The adoption of these systems has been held back by the cost of the devices themselves to support internet protocols because current methods require robust and relatively expensive radio, memory and microprocessor systems as compared to non-networked products. Adoption of internet connected products have also been held back by the cost to support application servers that provide web or internet functionality for the device because the product provider is burdened with back-end infrastructure costs that increase the cost of the product. Inventions that reduce the cost of connected devices while maintaining their internet connected functionality and inventions to improve the efficiency of the back-end infrastructure to support connected products are needed improvements to the current art.

SUMMARY

Electronic devices communicate through firewall connected through proxy and web application servers to internet network. Alternate embodiments of electronic devices use gateway or dongle and personal computer (PC) to connect one or more internet products to firewall. A unique identifier stored in each electronic devices or internet products corresponds to and addresses each electronic devices or internet products throughout system. Program in electronic devices, gateway, or PC transfers unique identifier through firewall by internet message system (IMS) protocol to proxy server software which detects electronic devices. IMS protocol includes unique identifier. IMS packet length is shorter than corresponding web service protocol packet length. Program in proxy server has routing and translating programs which alternatively are in IMS and Translation servers respectively. Routing program routes IMS packet based on stored mapping of unique identifier to internet protocol (IP) address and port to one electronic devices or internet products or, through translating program, to web application server with internet address using web service protocol. This enables internet address using web service protocol to access or communicate information, content, or commands to one electronic devices or internet products or enables one electronic devices or internet products to communicate to other electronic devices or internet products. In an alternate embodiment, application state or key value pair message associated with electronic devices are stored by software in proxy server.

Gateway or dongle communicates to one or more internet products through compact radio protocol (CRP) through low power wireless circuits. CRP packet length is shorter than corresponding IMS packet length. CRP packet using unique identifier has fewer fields than corresponding IMS packet. Software in gateway or PC translates CRP to and from IMS protocol.

Firewall table entry timeout time which blocks IMS transfer from proxy server to electronic devices or internet products is avoided by electronic device or proxy server software which determines approximation short of timeout time and is used to send IMS packet periodically to firewall preventing timeout and permitting communication with reduced system overhead.

In alternative embodiments; gateway or PC stores IMS or CRP packet sent until one or more internet products periodically wake up from low power sleep mode to receive packet to reduce power consumption in internet products, or alternatively, low power wireless circuit determines reduced signal strength condition which initiates resynchronization scan to gateway, or alternatively, firewall is with network address translation.

In alternative embodiments electronic devices or internet products may be; thermostat with ability of storing control setting, animatronic toy with motor causing motion or character gesturing and control circuit with ability to actuate motor, toy with ability to make sound or play sound files and ability to receive sound or sound files from internet address using web service protocol, medical sensor with ability of sending data, and touch screen display drawing pad with ability of sending data. All these abilities are responsive to internet address using web service protocol and touch screen display drawing pad is capable of sending data to another touch screen display drawing pad. Alternative embodiments in combination with above embodiments of animatronic toy use sensor with ability of sending sensor data responsive to motion or environment from toy to internet address web service protocol or to other electronic devices with ability to be responsive to animatronic toy.

Using more compact packet protocols than web service protocols within internet product system enables simpler and cheaper hardware throughout system and resulting operational efficiencies enable many more internet products to be connected than prior art techniques while also reducing cost of server infrastructure. Translating back to web service protocol at web application server also provides standardized web service interface helping application developers bring applications online more efficiently. Using unique identifier addressing enables efficient detection and access of electronic devices or internet products thru firewalls otherwise difficult to achieve using prior art IP based addressing. Embodiments described above enable many internet product connected applications that would otherwise be too expensive using prior art techniques.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a simplified system diagram showing the wireless internet product system according to an embodiment of the present invention.

FIG. **2** is a functional diagram illustrating the scan frame according to an embodiment of the present invention.

FIG. **3** is a functional diagram illustrating the poll frame according to an embodiment of the present invention.

FIG. **4** is a functional diagram illustrating the data frame according to an embodiment of the present invention.

FIG. **5** is a functional diagram illustrating the procedure of the internet product scanning to find gateways according to an embodiment of the present invention.

FIG. **6** is a functional diagram illustrating the procedure of polling when the internet product is in sleep mode and connected to the gateway according to an embodiment of the present invention.

FIG. **7** is a functional diagram illustrating the procedure of polling and scanning when the internet product is in sleep mode and not connected to the gateway according to an embodiment of the present invention.

FIG. **8** is a functional diagram illustrating the procedure of data frame transmitting with retries during normal operation according to an embodiment of the present invention.

FIG. **9** is a functional diagram illustrating the procedure of poll and data frame transmitting when the poll frame is held during normal operation according to an embodiment of the present invention.

FIG. **10** is a functional diagram illustrating the procedure of scan frame transmitting when the gateway is powered on and selects a random channel according to an embodiment of the present invention.

FIG. **11** is a functional diagram illustrating the procedure of data and poll frame transmitting during normal gateway operation according to an embodiment of the present invention.

FIG. **12** is a functional diagram illustrating the procedure of data and poll frame transmitting when a second internet product poll is delayed by a first internet product poll frame during normal gateway operation according to an embodiment of the present invention.

FIG. **13** is a functional diagram illustrating the IMS on UDP on IP packet according to an embodiment of the present invention.

FIG. **14** is an operational flowchart illustrating process steps performed by software functions in accordance with detecting and accessing functions in an internet product system according to an embodiment of the present invention.

DETAILED DESCRIPTION

One embodiment of the invention is an internet product system or sometimes called the wireless internet product system **100** as shown in the simplified system diagram FIG. **1**. The system consists of a one or more internet products **102** which are battery or wall powered devices that send and receive information through wireless radios through a one or more gateways **104**. "Low-power wireless" or simply "wireless" refers to 802.11a/b/or g/ standard and other proprietary and standard short-range wireless solutions capable of transferring digital data and operating in unlicensed spectrum, for example 433 MHz, 928 MHz, 868 MHz, 2.4 GHz bands and others (examples including WI-FI®, BLUETOOTH®, WIBREE®, ZIGBEE®, ZWAVE®, and others). The one or more internet products have a low-power radio transceiver and a microcontroller with data storage, for example flash or static random access (SRAM) memory. One or more internet products **102**, which may simply be called the internet product, connects to one of one or more gateway **104**, which may simply be called the gateway, using a compact radio protocol (CRP) **106**. The CRP uses a star topology where one or more internet products communicate with the same gateway.

Gateway **104** also has a low-power radio transceiver and a microcontroller with flash and SRAM memory. The gateway contains software to translate the CRP **106** packets to and from an Internet Message System (IMS) protocol **108**, **114**, and **120**. The IMS packets are sent over internet protocol (IP) through a network address translation (NAT) firewall **110** to an IMS server **112**. NAT firewall **110** may simply be called a firewall or NAT but is understood to be any device that blocks unauthorized packets from flowing to the gateway from any servers based on a predetermined rule set or providing the network address translation function.

The gateway exists in one of two configurations. The gateway may connect via a local area network (LAN) connection **114** (such as ETHERNET®) directly to the home or commercial network address translation NAT firewall **110** or router shown in FIG. **1**, or it may connect via a universal serial bus (USB) connection **116** to a personal computer (PC) **118**, which in turn is connected via local area network connection **120** (such as ETHERNET®) to the home or commercial network NAT Firewall **110** or router. The gateway may have both USB and ETHERNET® interface to allow the user to choose which method to use to give the gateway internet connectivity. In the case of the USB-connected gateway (**104**, **116**, and **118**), the translation software runs as a background PC **118** application program that sends and receives compact radio protocol CRP **106** and IMS protocol **120** information. Both the direct ETHERNET®-connected **114** gateway and USB-connected **116** gateway and PC combination will be referred to in this document simply as the "gateway **104** (or **104**, **116**, and **118**)". As described in more detail later, one embodiment of the USB-connected **116** gateway uses a USB dongle (not shown in FIG. **1**) in place of gateway **104** where the USB dongle (as **104**) contains the wireless radio as described above.

IMS server **112** routes IMS over user datagram protocol (UDP) over IP packets to and from one or more internet products **102** and their destinations. There are two possible destinations. The one or more internet products may communicate with another one of one or more internet products directly, or it may communicate with a web application server **122**. An example of the web application server in this case would be a server that provides a web interface that both shows information sent from the one or more internet products and sends information, content or commands to the internet product.

In the case where the internet product is communicating with another internet product directly, IMS server **112** passes the IMS packet to the correct one or more internet products **102** based on a device identifier (ID) found in the IMS packet. The packet is routed directly by the IMS server to the target product's NAT firewall **110** and gateway **104** (or **104**, **116**, and **118**). Note that if an internet product is behind an NAT firewall that does not allow UDP traffic, IMS server **112** can use transmission control protocol (TCP) instead of UDP, although TCP is less efficient.

Many of the one or more internet products are deployed in networks behind NAT firewall **110** devices. These one or more internet products can be reachable from IMS server **112** any time they are in operation so that a message sent from another internet product or initiated from a web application can reach the internet product. However the NAT firewall prevents an outside IP address from contacting an internal IP address unless the contact was initiated by the internal IP address inside the NAT firewall. Those skilled in the art are familiar with a table entry in the NAT firewall that associates an external IP address and port with an internal IP address and port and permits packets to be passed from the external address to the internal address as part of an active communication session. This active communication session will time out on most NAT firewall equipment after a pre-set amount of time. This embodiment of the invention can overcome this NAT firewall restriction by having the internal device send regular, dummy IP packets initiated either from gateway **104** (or **104**, **116**, and **118**) component or from one or more internet products **102** at a frequency higher than the table entry timeout frequency in the NAT firewall. In doing so, the sender ensures that there will always be a valid entry in the NAT firewall table to permit communication from the IMS server to the gateway. When the internet product connects to the IMS server and it was previously disconnected, the new connection to the IMS server will be initiated by the internet product or the gateway in order to be passed by the NAT firewall.

The NAT firewall table connection state may be automatically refreshed by gateway **104** (or **104**, **116**, and **118**) upon any data packet transmission between one or more internet products **102** and gateway **104** (or **104**, **116**, and **118**) (described below). Alternatively, the internet product may refresh state via a scanning operation (also described below). This refresh operation may be performed at any energy-efficient time selected by the internet product, and is typically coordinated with other device operations to minimize power state transition energy.

In the case where one or more internet products **102** are communicating with web application server **122**, IMS server **112** passes the IMS packet to the web application server through a translation server **124**. The translation server translates IMS over IP **126** to and from a standard web service protocol **128** such as extensible markup language (XML) over hypertext transfer protocol (HTTP) by providing a web service application programming interface (API) to web application server **122**. This translation allows standard web application servers to communicate seamlessly with the entire internet product system using a standard web service protocol. "Web service" refers to machine-to-machine communications using XML over HTTP. Translation server **124** can also provide a generic way to store the states of the various one or more internet products **102** so the state of the product can be retrieved from the translation server rather than the internet product to increase efficiency.

Translation server **124** advantages over the prior art are now described. By translating a standard web service protocol **128** to IMS over IP **126**, translation server **124** both provides a standard web service API to web application server **122** and also communicates with IMS server **112** using the more efficient IMS packet structure. This topology has several benefits. First, the XML format for the web service interface, although standard for web application servers, is much less efficient than IMS over IP. Translating packets as soon as they are received by the translation server to the more compact IMS format **108**, **114**, **120**, and **126** saves processor, memory, and bandwidth resources throughout the system as compared to passing data in XML format to other servers and/or down to one or more internet products **102**. Secondly, by using the IMS packet format to communicate from the translation server to the IMS server, the IMS server can be simpler and therefore more efficient than a standard server such as a web server, since communication on both sides of IMS server **112** uses the same high-efficiency IMS over IP **126** and **108** protocol.

In addition, translation server **124** defines a standard interface to access internet-connected products in both representational state transfer (REST), simple object access protocol (SOAP) or other web service formats and provides a generic way to store the states of one or more internet products **102**. Internet product state storage can be implemented at the translation server in two ways. First, one or more internet products **102** can send an application state to translation server **124** for storage and web application server **122** can retrieve each named property from the translation server. In this method the translation server acts as a cache for the internet product. The second more generic way to implement storage at translation server **124** is to have the translation server store a list of key value pair messages sent from one or more internet products **102** to the web application. Web application server **122** can then retrieve all the stored key value pair messages on translation server **124** or choose to retrieve only a subset of the messages based on their key. It will dramatically reduce the cost of development of the related web applications because a designer needs to understand only the web service API for communicating with one or more internet products **102** and not any of the details of the IMS or CRP protocols that they use to communicate.

CRP **106** advantages over the prior art are now described. Small data sizes are common for one or more internet products **102** on low-power wireless networks to facilitate less capable and therefore less expensive radio and packet processing hardware. The overhead of UDP or TCP normally imposed by an IP-based protocol is not needed by hardware of this type and creates and unnecessary inefficiency. The CRP **106** uses fewer fields and smaller headers than UDP/IP or TCP/IP, and the maximum packet length for CRP **106** is shorter than that of UDP or TCP. As a result, the CRP leads to higher efficiency in transferring user payload data for hardware that does not require a higher-level protocol. For low-power wireless networks, this added efficiency is an advantage.

IMS protocol advantages over the prior art are now described. One of the features of IMS protocol **108**, **114**, **120**, and **126** is that it is close to a direct mapping of CRP **106** to a simple format that can be sent over an IP network. The IMS protocol follows the size restrictions and formats of the CRP even though UDP or TCP would ordinarily not need to follow such restrictions. Limiting use of UDP or TCP packets to the subset IMS protocol goes against the current teaching in the art, as the packets are smaller than would be optimal for operation on an IP-only network. However the use of IMS protocol **108**, **114**, **120**, and **126**, while not optimal for an IP-only network, makes the translation by gateway **104** (or **104**, **116**, and **118**) to and from a CRP **106** packet in an IMS-based network, much simpler. For example, the IMS protocol restricts packet size such that there are no packets that are too large to be supported by the CRP. It thereby ensures that no packets need be broken up into smaller packets when translated by the gateway to the low-power radio network, reducing the complexity and therefore the cost of the gateway.

Keeping the IMS packet structure close to the CRP packet structure also has the benefit of making it easier to have compatibility between the Ethernet-connected **114** gateways and gateways that connect to a PC via a serial connection such as USB connection **116**, since the complexity of the gateway translations are greatly simplified. A less complex gateway is easier and less expensive to implement on limited embedded hardware.

A key feature of IMS protocol **108**, **114**, **120**, and **126** is the use of a connectionless protocol such as UDP for a majority of communications between one or more internet products **102** and IMS server **112**. For a traditional server such as Web Server, both the TCP connection overhead and the need to retain state for typical communication transactions consumes memory and processor resources on the server reducing the number of internet products that can be connected to the server simultaneously. Using the connectionless protocols in conjunction with the design of transactions using the IMS protocol, allows the minimum state for common transactions to be stored on the IMS server. Storing little state and using connectionless protocols such as UDP allows IMS server **112** to process transactions for many more internet products than can be processed by server architectures currently used in the art that rely on connection-oriented protocols such as TCP. Using TCP would consume more system resources such as threads, file descriptors, etc. For a traditional server such as web server, both the TCP connection overhead and the need to retain state for common transactions consume memory and processor resources on the server reducing the number of internet products that can be connected to the server simultaneously. Correspondingly, the IMS server may be designed with low-cost hardware, using comparatively little bandwidth, while serving many internet products simultaneously.

To improve the availability and balance the traffic load, IMS server **112** is designed and implemented as a cluster server using distributed memory cache technologies. Considering the tradeoff between performance and guaranteed data replication, and also considering the cost-sensitive nature of the consumer electronics market, the data replication among the multiple cluster nodes is designed in a best effort fashion. Occasional out-of-synchronization of data among the server nodes in the cluster due to network failure can be resolved by automatic audit and resynchronization, or by a restart of one or more server nodes. The databases used as a component of the IMS server, which contain the description of internet-connected products, are also entirely replicated to multiple server nodes in the cluster. This eliminates the need for the database replication server and expensive storage hardware and at same time achieves good results in terms of data recovery.

To further simplify the recovery process, each main description data entry of one or more internet products **102** is assigned to one primary server node. The database record in its primary server node will be the master record of that entry. IMS server **112** routes all the update requests of the main description entries to their primary server node so that the master record is always updated first and then replicated to other server nodes in the cluster. All databases in the cluster will be recovered automatically based on their master records when system restarts by using above technique. The databases can also be recovered easily with minimum manual intervention in major disk failure. It can dramatically reduce the data recovery cost and time.

More efficient protocols save cost. Prior internet-connected products, including some that have used web service directly on the internet product, have used HTTP to communicate to send and receive data between devices and internet servers. This invention embodiment uses web service protocol **128** to connect to web application server **122**, but translates the connections to more efficient UDP IMS protocols **108**, **114**, **120**, and **126** for other communication points within the architecture. This has the benefit of providing standard web application server interfaces while eliminating the overhead that would be incurred if complicated http and xml protocols were used with one or more internet products **102** and core IMS server **112**. The overhead of HTTP and XML protocols would normally make one or more internet products **102** more expensive because they would need full TCP and HTTP and XML capability, requiring more SRAM, flash memory, and a higher performance processor. This invention embodiment allows one or more internet products **102** to be less expensive. The server infrastructure to support one or more internet products that used TCP UDP XML and or Web service would also be more expensive than this embodiment of the invention as more data would need to be passed between the internet product and the server. Additionally the server would need to maintain more state on each connected product, requiring more memory and processing resources on the server, and thus reducing the number of internet products each server could support.

The following embodiment provides additional enhancements. Periodic NAT firewall table refresh operations by one or more internet products **102** or gateway **104** (or **104**, **116**, and **118**) introduce a certain amount of communication overhead. Often, for a battery-powered internet product, packets sent down to the internet product will be stored in the gateway, and the internet product will periodically wake up from a low power sleep mode to query the gateway to see if there are any such packets that the gateway needs to transmit to the internet product. In one embodiment, this periodic data can double as a NAT firewall refresh request, triggering a dummy IP packet to be sent from gateway **104** (or **104**, **116**, and **118**) to IMS server **112**. This double use of a data query packet from one or more internet products **102** to the gateway to trigger the dummy IP packet to be sent from the gateway to the IMS server is more efficient than handling the two functions separately. In addition, this technique makes the design of the gateway component simpler as it no longer needs to keep track of the state of one or more internet products that are active on the wireless network and must therefore maintain regular dummy packet traffic to the IMS server to ensure the internet product is reachable by the IMS server. The timers for determining when a dummy packet needs to be sent are in one or more internet products **102** and not in gateway **104** (or **104**, **116**, and **118**) so the gateway design can be simpler and therefore less expensive. A dummy IP packet or any other IMS packet is sent through NAT Firewall **110** to IMS server **112** to make sure the state in the NAT Firewall reflects that there is an active connection between the IMS server and the internet product such that IP packets from the IMS server sent to the internet product are not blocked by the NAT firewall because there is no current state in the NAT firewall associating and therefore permitting the IMS IP address to send IP packets to the internal IP address of the internet product's gateway.

A second enhancement is as follows. In one embodiment of the invention, IMS server **112**, gateway **104** (or **104**, **116**, and **118**), or one or more internet products **102** requests a succession of dummy packets to be sent from the gateway to the IMS server and, over time, increase the send period between dummy packets. The IMS server will then attempt to communicate with the gateway or internet product at increasingly longer periods of time after the send time of the last dummy packet. Eventually when the IMS server sends an IP packet it does not receive a response from the gateway or internet product because the IP packet was blocked due to the timeout of the table entry in NAT firewall **110** permitting the traffic from the IMS server to the gateway. By recording the longest delay from dummy packet to a successfully transmitted packet from the IMS server to the gateway, the timeout period for the NAT firewall can be approximated, and a value determined for the maximum period between dummy packets to maintain the NAT firewall table state. To ensure more dependable or higher accuracy results this NAT firewall timeout test can be repeated. By gauging the approximate timeout period, the slowest and therefore most bandwidth efficient refresh rate can be selected for refresh requests on the wireless network. This NAT firewall timeout test can be initiated and or directed from either IMS server **112**, gateway **104** (or **104**, **116**, and **118**) or one or more internet products **102**.

Another embodiment is now described. Since the one or more internet products **102** are often powered by low-cost battery sources, a design consideration is the reduction of the internet product's network power consumption. Gateway **104** (or **104**, **116**, and **118**), in contrast, is assumed to be powered by external supply and may therefore operate with reduced consideration to power consumption. This necessitates a network protocol in which the internet product has minimal transmission overhead, while the gateway may operate in a less energy optimally fashion in order minimize internet product energy requirements.

In the embodied radio and network protocol, the internet products operate in a decoupled fashion whereby one or more internet products **102** do not maintain connection or synchronization information for other internet products, including those currently associated with the same gateway. Rather, the connection state is maintained solely in the gateway. The internet product is only periodically required to refresh connection state within a predefined period of time in order to maintain a current NAT firewall **110** table entry within the gateway.

One embodiment of the invention is providing low-latency, highly energy efficient delivery of data packets. This is done through an energy-efficient radio and network protocol design (CRP) and efficient caching of data packets at a gateway's radio. Caching is provided via queuing data packets in gateway **104** (or **104**, **116**, and **118**) which are destined for any currently associated one or more internet products **102** currently associated with that gateway. This reduces network power consumption by eliminating the requirement to relay data requests to IMS server **112**. In the gateway, data packets are presorted chronologically and by internet product identifier in order to optimize packet lookup time. Data is transferred only when requested by one or more internet products **102** via a poll request (described in following sections). This reduces network power consumption of the internet product by eliminating the requirement to relay each data request separately to the IMS server. In the gateway, data packets are presorted chronologically and by internet product identifier in order to optimize packet lookup time. The internet product may optimally coordinate data transfer with other activities as well as optionally batch data transfers in order to minimize power state transition overhead.

Since the one or more internet products **102** are often powered by low cost battery sources, a paramount design consideration is the reduction in the internet product's network power consumption. Gateway **104** (or **104**, **116**, and **118**) in contrast is assumed to be powered by external supply and may therefore operate with reduced consideration to power consumption. This necessitates a network protocol in which the internet product has minimal transmission overhead, while the gateway may operate in a less energy optimally fashion in order minimize internet product energy requirements. In the embodied radio and network protocol, the internet products operate in a decoupled fashion whereby one or more internet products **102** do not maintain connection or synchronization information for other internet products, including those currently associated with the same gateway. Rather, the connection state is maintained solely in the gateway. The internet product is only periodically required to refresh connection state within a predefined period of time in order to maintain connection state within the gateway. The connection state is automatically refreshed by the gateway upon any data packet transmission between the internet product and gateway. Alternatively, the internet product may refresh state via a scanning operation (described below). This refresh operation may be performed at any energy efficient time selected by the internet product, and is typically coordinated with other operations to minimize power state transition energy.

An additional embodiment in the invention of the internet product and gateway is the ability of one or more internet products **102** to resynchronize with one or more gateways **104** (or **104**, **116**, and **118**) to provide a roaming capability. The internet product may initiate a scan for additional gateways existing in the environment either periodically, or when a reduced received signal strength from the currently associated gateway is detected. When the scan procedure locates a gateway with adequate signal strength, as described by the scanning process in following sections, the internet product will associate with the new gateway by initiating a login process with IMS server **112**. This indicates to the IMS server that the internet product has roamed to a new gateway and that all future transactions should be routed to this gateway. The internet product, also called a "handset" in these descriptions, remains associated with the former gateway until the IMS server login has successfully completed. The process creates a novel capability for one or more internet products to have mobility through a continuous re-association process with both gateways and the IMS server connections.

Another embodiment of the invention is an automatic channel selection scheme initiated by gateway **104** (or **104**, **116**, and **118**) upon power-on or when the active channel noise floor reaches a threshold indicating radio interference from unknown noise sources. The gateway, whose receiver is continuously monitoring the selected communications channel frequency, will monitor the current channel transmission quality. Channel quality is determined both by the presence of undesirable noise as well as occupancy by other gateways.

Measurement of undesirable noise is performed by enabling the receiver and periodically sampling the receiver's low noise amplifier receive signal strength indicator. This signal is proportional to the amount of power detected in the radio channel at the selected frequency band. The periodic sampling records both the average and peak values over a specified sampling period. If either peak or average values are measured to be above predefined constants (this detects both ambient noise and burst transmission interference), then the channel is removed from the candidate channel list.

To detect occupancy gateway **104** (or **104**, **116**, and **118**) both actively and passively solicits the presence of other gateways on the candidate frequency channel. In this mode, the gateway requests a reply from any nearby gateways on the same frequency channel. The gateway then receives responses any from responding gateways. At the same time, the channel is passively monitored for transmissions between any nearby one or more internet products **102** and gateways. During the listening period, the total number of bytes in all received packets is summed. This value is used to estimate the channel occupancy ratio. If this occupancy ratio exceeds a threshold value, the channel is considered occupied and removed from the candidate list. Once all channels have been scanned for noise and occupancy and the undesirable channels removed from the candidate list as described above, gateway **104** (or **104**, **116**, and **118**) selects the active frequency channel through a uniformly random selection from the candidate list.

The internet product to gateway CRP **106** is described in the following sections. FIG. **2** is a functional diagram illustrating the scan **200** frame used as an internet product scan for gateways according to an embodiment of the present invention. Scan **200** is sent once one each hopping channel at initial system synchronization to locate gateways. Scan **200** has a maximum transmit time for initiating one or more internet products **102** or gateway **104** (or **104**, **116**, and **118**) of 1.92 ms or for the gateway of 2.8 ms. The scanning frame is shown for use with either handset or USB dongle. Scan **200** frame includes Scan ACK packet TX **201** which includes an 11 byte header field, a 0-11 byte payload field, and a 2 byte cyclic redundancy check (CRC) field. The header includes a destination address field of 4 bytes, a 4 byte source address field, a 1 byte length field, a 1 byte flags field, and a 1 byte sequence number field.

FIG. **3** is a functional diagram illustrating the poll **300** frame used for gateway **104** (or **104**, **116**, and **118**) to one or more internet product **102** data transfers according to an embodiment of the present invention. Poll **300** has a polling frequency of 1 Hz, and has a maximum transmit time for gateway **104** (or **104**, **116**, and **118**) of 15.52 ms or for the one or more internet products **102** of 3.84 ms. The polling frame is shown for use with either handset or USB dongle. Poll **300** frame includes Data packet TX **301** which includes an 11 byte header field, a 0-147 byte payload field, and a 2 byte cyclic redundancy check (CRC) field. The header includes a destination address field of 4 bytes, a 4 byte source address field, a 1 byte length field, a 1 byte flags field, and a 1 byte sequence number field.

FIG. **4** is a functional diagram illustrating the data **400** frame used for one or more internet products **102** to gateway **104** (or **104**, **116**, and **118**) data transfers according to an embodiment of the present invention. Data **400** has no maximum transmit frequency, has a maximum of 2 retries with exponential back off, and has a maximum frame transmit time for one or more internet products **102** of 13.6 ms or for gateway **104** (or **104**, **116**, and **118**) of 1.92 ms. The data frame is shown for use with either handset or USB dongle. Data **400** includes Data packet TX **401** which includes an 11 byte header field, a 1-147 byte payload field, and a 2 byte cyclic redundancy check (CRC) field. The header includes a destination address field of 4 bytes, a 4 byte source address field, a 1 byte length field, a 1 byte flags field, and a 1 byte sequence number field.

An embodiment for multiple data transfers to and from a single gateway **104** (or **104**, **116**, and **118**) by one of one or more internet products **102** is described next. Each one or more internet products **102** is limited to one data **400** or poll **300** frame transfer attempt per 100 ms. Likewise the gateway will not respond to more than one data or poll request within any 100 ms time frame. Since each internet product may be actively associated with only one gateway, it will not send more than one data or poll frame in any 100 ms time interval. Since the gateway may be connected to up to 4 internet products, which are not time synchronized, the gateway will delay responding to any data or poll packets that arrive within 100 ms of any previous data or poll packet. This is required to achieve Federal Communications Commission (FCC) mandated activity duty cycling.

For one or more internet products **102** initiated data **400** frames, the delay is guaranteed by the carrier sense multiple access (CSMA) exponential back-off algorithm,

$$T_{backoff}=100+\text{rand}[0-15]\ll \text{retry\#}\text{ ms.}$$

For any successful data **400** or poll **300** frame transfer, there is a 100 ms delay on the transmitter lock to prevent any additional frames from being transmitted.

FIG. **5** is a functional diagram illustrating the procedure **500** of one or more internet products **102** scanning to find one or more gateways **104** (or **104**, **116**, and **118**) using 16 available channels as an example according to an embodiment of the present invention. The internet product performs a scan for all gateways after user login and when the user selects 'Reconnect' from the menu options. This can also automatically be performed upon loss of connection or when receive signal strength indicates poor connectivity to the currently associated gateway. The scan for gateways is performed by sending scan frames sequentially on each available channel.

The scan **200** frames are separated by a 20 ms back-off period. The maximum total transmit time from any internet product in a 100 ms period would be,

$$\text{ceil}(100/(20+1.92))*1.92\text{ ms}=9.6\text{ ms.}$$

FIG. **6** is a functional diagram illustrating the procedure **600** of polling when one of the one or more internet products **102** is in sleep mode and connected to gateway **104** (or **104**, **116**, and **118**) whereby the internet product will send a single poll **300** frame once per second according to an embodiment of the present invention. Poll **300** frames are sent to the associated gateway. There are no retries for any lost sub-frame elements in the poll frame. Lost data will be resent in the following poll frame occurring 1 second later. The maximum transmission time for any internet product in sleep mode during a 100 ms interval will be a single poll frame (3.84 ms).

FIG. **7** is a functional diagram illustrating the procedure **700** of polling and scanning when the internet product is in sleep mode and not connected to the gateway according to an embodiment of the present invention. When one or more internet products **102** is in sleep mode and not connected to gateway **104** (or **104**, **116**, and **118**) or if the connection to the associated gateway is lost during sleep, the internet product will perform a new gateway scan **300** (see procedure **500** embodiment of internet product scan for gateways above) once every 30 seconds instead of performing the normal poll **300** frame transmission. The internet product maximum transmission time in any 100 ms interval will be the maximum of the poll frame transmission and the scan for gateways given by,

$$\text{MAX}(3.84,9.6)=9.6\text{ ms.}$$

In one embodiment for the internet product in normal operation there are both poll **300** frames transmitted once per second as well as data **400** frames transmitted only when the internet product user initiates some action through a key press. The two frame types are asynchronous to one another with the restriction that only one data or poll frame may be sent in any 100 ms time interval. FIG. **8** is a functional diagram illustrating the procedure of data **400** frame transmitting with retries **800** during normal operation according to an embodiment of the present invention. The retry interval is given by the previously defined exponential random back-off calculation. FIG. **9** is a functional diagram illustrating the procedure **900** of poll **300** and data **400** frame transmitting when the poll frame is held during normal operation according to an embodiment of the present invention. When a data frame occurs within 100 ms of a scheduled poll frame transmission time, the poll frame is held until the 100 ms delay occurs. The maximum transmission time in any 100 ms interval will be the maximum of a single poll or data frame given by,

$$\text{MAX}(3.84,13.6)=13.6\text{ ms.}$$

FIG. **10** is a functional diagram illustrating the procedure **1000** of scan **200** frame transmitting when the gateway is powered on and selects a random channel according to an embodiment of the present invention. When gateway **104** (or **104**, **116**, and **118**) is powered on, it selects a random channel i (where i is in the range 1 to 16 in this example). The gateway then sends a single scan **200** frame to test for existing gateways on the current channel. Gateway then receives for 1 second to determine if the received signal strength indication (RSSI) reading indicates too much noise on the channel, which indicates potential interference from other radiators. If no interference is found, the gateway will send an additional scan frame to probe for existing gateways. If no other gateways are found, the gateway proceeds to the operational mode. If the channel is occupied by another gateway, or if there is interference from other radiators on the current channel i, the internet product will select a new random channel j between 1 and 16 and repeat the described channel probing process. The maximum transmit time for a gateway during any 100 ms interval during startup will be a single scan frame (1.92 ms).

FIG. **11** is a functional diagram illustrating the procedure **1100** of data **400** and poll **300** frame transmitting during normal gateway **104** (or **104**, **116**, and **118**) operation according to an embodiment of the present invention. In this embodiment, the gateway has no sleep or standby modes as detailed for the internet product. Likewise the gateway does not initiate transmissions to any handset other than in the gateway's power on stage described above. Transmission time is limited at the gateway by servicing only a single data **400** or poll **300** frame in any 100 ms interval. If a data or poll frame arrives from another internet product within 100 ms of servicing any current poll frame, the response is delayed until the 100 ms wait has transpired. The maximum transmission time in any 100 ms interval will be the maximum of a single data or poll frame given by,

$$\text{MAX}(1.92,13.6)=13.6\text{ ms}.$$

FIG. **12** is a functional diagram illustrating the procedure **1200** of data **400** and poll **300** frame transmitting when a second internet product poll **300** is delayed by a first internet product poll **300** frame during normal gateway operation according to an embodiment of the present invention. If any poll or data **400** frame arrives at the gateway within 100 ms of the previous poll or data frame, the gateway will delay the ACK response packet until the 100 ms delay has occurred.

FIG. **13** is a functional diagram illustrating the previously described IMS on UDP on IP packet **108**, **114**, **120**, or **126** structures according to an embodiment **1300** of the present invention. The previously described CRP **106** packet (13-160 bytes) is loaded on a UDP packet as a UDP payload. The UDP packet further has a 4 byte UDP header and may have an added 20 byte IMS header. The UDP packet is then loaded as an IP packet payload. The IP packet also has a 20 byte header. The total IMS packet is then 57-204 bytes long and substantially smaller than the maximum standard web service UDP packet length of 65,507 bytes. The practical limit for other embodiments of an IMS packet length is estimated to be less than 500 bytes.

FIG. **14** is an operational flowchart illustrating process steps performed by software functions in accordance with detecting one or more internet products **102** by the internet product system **100** and a subsequent accessing or communication dialog between web application server **122** and one or more internet products **102** in an internet product system **100** according to an embodiment **1400** of the present invention. In this embodiment description one or more internet products **102** and gateway **104** (or **104**, **116**, and **118**) are combined into one or more electronic devices ((**102**, **106**, and **104**) or (**102**, **106**, **104**, **116** and **118**)), as would be obvious to one of average skill in the art, to more easily teach the concepts of the invention. It should be noted that, as previously described in detail, the internet product may communicate in CRP within the electronic device which in turn communicates in IMS protocol at other connection points (**108**, **114**, **120**, or **126**) within wireless internet product system **100**. Neither the internet product nor the electronic device communicates directly in web service protocol **128** (XML/HTTP for example). Instead, both the internet product and the electronic device rely on the rest of the invention to provide translation and mapping of the simpler CRP and IMS protocols into web service compatible protocol as outlined below. Also, to more easily convey the concepts of the invention, IMS server **112** and translation server **124** are singly combined into a proxy server (**112** and **124**).

At the start **1410**, a dynamic IP address and port is allocated **1412** to NAT firewall **110**. The electronic device sends **1414** a sign-on message to the firewall. The NAT firewall attaches **1416** the IP address and port to the sign-on message and forwards the combined sign-on message to the proxy server. The proxy server sends **1418** a NAT firewall traversal information to the firewall. The NAT firewall forwards **1420** the traversal information to the electronic device. The electronic device sends **1422** a unique identifier to the firewall. The NAT firewall forwards **1424** the unique identifier to the proxy server. This completes the detection phase of the procedure. The proxy server creates **1426** a mapping between the unique identifier and the IP address and port. The proxy server stores **1428** the mapping for later translation enabling internet product system **100** to use the unique identifier as an address throughout the system. The internet product's unique identifier is recognizable even when an internet product's IP address changes for instance if a product is moved from one gateway environment to another or from one NAT firewall to another.

The next phase of the flow chart embodiment **1400** in FIG. **14** shows how web application server **122** accesses the electronic device (and one or more internet products **102** within) in an access or communication dialog. Web application server **122** sends **1430** an web service protocol **128** (XML/HTTP) request to proxy server (**112** and **124**) using the unique identifier as an address for one of the one or more electronic devices **102** (or one or more internet products **102** within). The proxy server translates **1432** the web service protocol **128** XML/HTTP request to an IMS protocol **108** request. Proxy server (**112** and **124**) maps **1434** the unique identifier address used by the web application server to the previously stored corresponding IP address and port of NAT firewall **110**. The proxy server sends **1436** the translated IMS request to NAT firewall **110**. The NAT firewall sends **1438** the IMS request to one of the one or more electronic devices **102**. The electronic device (internet product) performs **1440** the request and then sends an IMS protocol **114** or **120** response to the firewall. The NAT firewall sends **1442** IMS protocol **108** response to proxy server **112** and **124**. The proxy server translates **1444** the IMS response to web service protocol **128** XML/HTTP response. The proxy server sends **1446** the translated web service protocol XML/HTTP response to web application server **122** completing the accessing or communication dialog phase which ends the entire sequence of steps **1448** of the flow chart embodiment **1400**.

Various embodiments using the wireless internet product system **100** are described next. One of these various embodiments of the invention is an internet drawing pad that can be made as a toy for children to create and share drawings and messages over the internet, or as a communication device for adults to send drawings and messages over the internet. One or more internet products **102** are made up of a touch screen display, a microcontroller and the previously described low-power wireless radio. The user of the drawing pad would use her finger tip or a stylus to create drawings and or pictures on the touch-sensitive screen known to those skilled in the art. The location of the pressed stylus or figure is recorded on touch-sensitive sensor layers that overlay the screen. The microcontroller converts the signals from the touch interface to vertical and horizontal coordinates using standard touch screen sensor methods known to those in the art. The horizontal and vertical pixels corresponding to the locations of the pressed screen are then recorded in the writable memory available to the microcontroller and a bit map of the drawing or message is stored in the memory of the drawing pad. The user of the internet drawing pad can then choose to send the drawing to one of several locations where the drawing or message can be viewed. In all cases the message or drawing is sent through wireless internet product system **100**.

Drawings or messages can be sent to one or more internet drawing pads though internet product system **100** described above. One method for addressing a drawing pad is to have each pad have a unique serial number assigned to each unit at manufacture. Users can enter the serial number of other pads to which they wish to send drawings or messages on the drawing pad or enter the serial numbers on a web application configuration page associated with the user's drawing pad.

The drawing or message can also be sent to an email gateway where the drawing or message will be attached to an email message and sent to an email address. The drawing or message is passed to an email gateway where the drawing or message will be sent to an email address by web application server **122** that has both an interface to IMS server **112** via the IMS protocol and to an email server to send messages over a protocol such as simple mail transfer protocol (SMTP). An email gateway is a special case of web application server **122** that is connected to translation server **124** via web service protocol **128** interface and has a mail server known to those skilled in the art, for sending and receiving data via email. This email message will have an embedded or attached image of the drawing or message that has been converted to a standard internet format such as graphics interchange format (GIF) or joint photographic experts group (JPEG) format.

The drawing or message can be sent to or from a web application which uses a JAVA® or FLASH® interface to capture a drawing or message made by a user on a web page. The user would make this drawing by drawing with the mouse in a drawing pad web application and, for example, clicking on a send button which passes a message containing the drawing to the IMS server. The message is then sent to an internet pad through internet product system **100**. Additionally, drawing or messages can be sent from the internet pad to the web application and displayed to user on a website. In one embodiment the website could be a social networking website such as FACEBOOK® or MYSPACE®. Using the API programming interface for the social networking site, drawings or messages generated from pads could be displayed on the social networking site. Similarly a control could be created to allow the user on the social networking site to create a drawing or message and send it to an internet pad. The social networking application could directly communicate with IMS server **112** using the IMS protocol or the application could use the web service interface available through translation server **124**.

The next of these various embodiments of the invention is the embodiment where one or more internet products **102** are a digital camera capable of taking still photos or movies. The camera uses the radio internet system **100**. On set up, a user can associate one or more buttons on the camera with email addresses such that, when a photo is taken and an email button is pushed, the image is transferred though gateway **104** (or **104**, **116**, and **118**) and IMS server **112** to web application server **122** with an email interface and sent to the email address corresponding to that button. Pictures or videos can also be passed from the camera to web application server **122**. Then, using a web service interface, the pictures or videos can be transferred to a photo printing and/or media fulfillment company, which may create a photo or video product such as a print or DVD, and send the media product to the customer or another address the consumer selects. In one embodiment, the home address of the user is entered on a registration website when the camera is first purchased. When the print button is pressed on the camera, the currently-selected or displayed photo or photos are printed and mailed to the user's home address automatically. In one embodiment, the photo is transferred through the IMS network to an application which transfers the photo via a web service interface to an album on a photo sharing site hosted by a web application server.

The next of these various embodiments of the invention is the embodiment where one or more internet products **102** is a room or house alarm where a motion sensor on the alarm causes the alarm to send a signal to IMS server **112** and to web application server **122** which stores the time of the alarm trigger on an alarm website. The alarm is one or more internet products **102** and is connected to the internet product system **100** described above. In one embodiment, the owner of the alarm is automatically notified via email or short message service (SMS) message of the trigger. In one embodiment, the alarm, when triggered, takes a photo of the person or object that triggered the alarm and sends the digital photo file along with the alarm trigger signal to web application server **122** so that the photo can be displayed on the alarm website to help the user looking at the website understand the nature of the alarm.

The next of these various embodiments of the invention is the embodiment where one or more internet products **102** is a piece of health monitoring equipment such as a blood pressure sensor, blood glucose sensor, pulse oxygen sensor, heart monitor, body temperature sensor, or other medical or health sensor device referred to hereafter as a "medical sensor". The medical sensor has a radio system and is connected as an internet product to wireless internet product system **100** described above. When a user uses the medical sensor to make a measurement, the measurement data is sent through internet product system **100** to web application server **122**. The application server can then send the information to a web application that stores the medical data and presents it to the user, a care provider, or a family member through a secure web page hosted by the web application server.

The next of these various embodiments of the invention is the embodiment where one or more internet products **102** is a piece of exercise or weight training equipment such as a treadmill, elliptical trainer, stationary bike, weight training machine, or other exercise device referred to hereafter as "exercise equipment". The exercise equipment is one or more internet product **102** and therefore has a radio system and is connected to wireless internet product system **100** described above. When a user uses the exercise equipment, exercise data such as time spent exercising, calories burned, miles covered, difficulty settings, pace, and other relevant exercise information is sent through internet product system **100** to translation server **124** which then sends the information on to a web application on web application server **122** that stores the exercise data and presents it to the user or the users trainer through a web page. The exercise web page can also be used to design exercise programs that can then be sent through the internet product system **100** to the exercise equipment. Exercise programs can contain information such as the duration of the session, difficulty settings, changing profiles of difficulty and pace over the time of the workout, and other relevant parameters. If the exercise equipment is used by more than one person, the user would authenticate when she first starts using the exercise equipment by entering a pin number, swiping a magnetic card, using a radio frequency identification (RFID) device, inserting a USB device that contains authentication, or by using some other authentication method known in the art. Once the user is authenticated, the current exercise program is downloaded or a pre-downloaded exercise program is loaded for the user. Also, exercise data can be uploaded and associated with the correct user after authentication has taken place.

The next of these various embodiments of the invention is the embodiment where one or more internet product **102** is a thermostat for residential or commercial buildings. The thermostat installs as a standard programmable thermostat and replaces the user's existing thermostat if one is present. The thermostat is one or more internet product **102** and therefore has the radio described above, and is connected to wireless internet product system **100**. In one embodiment of the thermostat, the user registers the thermostat on a product registration website, entering in key characteristic data for the house or commercial building that the thermostat is to control. For example, such data could be the type, age and model numbers of the heater and air conditioner for the building, the input capacity of the heater and air conditioner, the zip code for the building location, the age of the building and the HVAC system, the efficiency of the heater and air conditioner, the square footage or cubic footage of the building, the type of construction, the number of windows, and/or any other data relevant to the heating or cooling of the building. At registration, the user also chooses a username and a password which set up a thermostat web application account.

Web application server **122** delivers web pages to the user which provide information and statistics gathered from the thermostat and allow the user to control thermostat settings such as the standard settings for a 7-day programmable thermostat, known in the art. The thermostat web application sends data to and collects data from the thermostat through web service protocol **128** interface on translation server **124**.

The web application is connected to internet data sources for weather information based on zip code, and sends outside temperature and weather forecast information, including cloud cover, rain, high and low temperatures for the day to the thermostat to the thermostat for display.

All thermostat settings and thermostat temperature and time program settings can be controlled though the web interface, allowing control of the thermostat from any internet enabled computer or device with a web browser and an internet connection.

The thermostat can also be controlled by a utility company or other authorized third party using the web service interface on the application server or web application server **122**. Example uses include turning off the heater or air conditioner or temporarily change the thermostat setting to reduce the energy demands the heating ventilation air conditioning (HVAC) system is imposing on the utility company's energy infrastructure. The thermostat and thermostat web site can display if the user is enrolled in this energy demand response system and whether the system is actively limiting HVAC energy usage. The thermostat and thermostat website can also provide information on the bonus accumulated by the user for her participation in the demand response system.

To determine the efficiency of the house, an estimate of the insulating efficiency of the house can be determined by raising the temperature of the house above the outside air temperature. The outside air temperature can be estimated since the user entered her city or zip code for the house when the thermostat was registered on the web page. The temperature for the zip code or city is obtain through web service interfaces known to those in the art, and then is sent from the thermostat web application server **122** to the thermostat through the wireless internet product system **100**. Once the temperature is above the estimated outside air temperature, the heater is turned off and the decay of the inside temperature is measured. Using the square footage measurement and other structure data entered by the user, and the rate of loss of heat as compared the size and characteristics of the structure, an estimate of heating or cooling loss can be recorded and presented to the user to provide information about how efficient the structure is.

The thermostat system also records how changes in the inside temperature setting selected on the thermostat affect the number of minutes per day that the heater or air conditioner must run to keep the structure at the set temperature. Once the number of minutes the heater must run is known, estimates of the cost of gas or electricity can obtained from regional averages or from pricing data from the users utility. In some cases the pricing data will be automatically obtained from government utility, or third party provider servers though the web service interface. Using the input energy capacity estimate, the total time the heater or air conditioner operated, and the cost of energy such as gas or electricity purchased from the user's utility company, a total cost estimate to heat and cool the structure can be obtained. Note that if the user's utility uses time of day pricing to compute the energy bill, the internet thermostat system will also record the time of day of each heating or cooling cycle in order to compute to total cost correctly.

The thermostat web application can also collect temperature history and temperature projections for the zip code, city, or address the user enters at registration time.

The internet thermostat system combines the structure data and temperature history to determine the estimated cost for heating and cooling the house in the future for a given set of temperature settings and program times. This allows the user to make "what-if" changes to her temperature settings and or thermostat program to see the estimated cost or savings of such a change over a time period of her choosing, for example one year. This estimate can be computed by the internet thermostat system in real time and displayed both on the thermostat website and on the display of the thermostat itself.

As the user changes the thermostat setting or changes the thermostat program, the thermostat calculates and totals the cost expense for the next day, week, month and year and presents them the user to help her evaluate the cost associated with energy choices. The difference in cost from the previous thermostat setting is also presented to help the user understand a cost or benefit projection due to her change in the thermostat temperature setting or thermostat program.

The next of these various embodiments of the invention is a small internet information display device which consists of a low-cost display containing the radio system, a microcontroller, an LCD controller, and driver hardware and software for controlling the display and processing input familiar to those skilled in the art. The internet information device is one or more internet product **102** and connects to wireless internet product system **100** described above. Information such as current and forecasted weather, stock and index prices, traffic maps with congestion illustrations, and/or movie ratings and times are gathered by a web application and sent to the application server to be distributed to the internet information display device.

In one embodiment of the internet information display device, the user registers the device on a product registration website entering in the key data characteristics for the use of the device such as the user's zip code, work commute destination, email server settings, account and login information for social networking sites such as FACEBOOK®, and instant messaging service such as AIM®, YAHOO®

INSTANT MESSENGER® or MICROSOFT® MESSENGER®, etc. At registration the user also chooses a username and a password, which sets up a website account on web application server **122**. The web application server hosts web pages that the user uses to change which information will be downloaded and displayed on his internet information display device.

The information device will then display the information types selected by the user on the display. In one embodiment, this information is constantly displayed on the screen. If there is more information than one screen can display, the device will display each screen for short period of time before changing to the next screen of information, freeing the user from having to touch buttons on the display to retrieve information. This makes the information display useful if the user looks at it from a distance, as no buttons will need to be pressed, which improves ease of use for the device.

In one embodiment, the user enters on the website associated with the display device, various alternative routes used in his commute. The web application uses web service interfaces to other web servers and web applications to get an estimated trip time for each possible route, factoring in the effects of current traffic congestion along with an optional shortest-time-route that may or may not have been entered by the user. The travel time for these routes is computed by the web application using the normal methods familiar to those in the art, and the travel times are transmitted through wireless internet product system **100** described above and displayed on the internet information device. The user can quickly glance at the device and see the current travel times for different routes to one or more chosen locations and pick the quickest route based on current conditions. To make the device useful for locations that are not preselected by the user, a map of the major roads and freeways indicating real-time congestion levels can also be displayed on the information device. The user's zip code and other location information are used to determine which maps should be sent to the information display device.

In one embodiment, web application server **122** queries the instant messaging and social networking sites using the account information provided by the user on the internet information device configuration web page. The web application then collects information from the instant messaging service such as which friends are currently online and sends this information to the internet display device to be displayed. The advantage the device provides is that the user only needs to look briefly at this device to determine if friends are online and ready to communicate instead of using a computer, personal digital assistant (PDA), or other multi-purpose device the requires more operational overhead.

In one embodiment, applications are written for a social networking site such as FACEBOOK® so that messages can be written from a user's home page on the social networking site and then passed to web application server **122** to be displayed on the user's internet information device.

In one embodiment, the internet display device is used as a client for a micro-blogging service such as TWITTER®. The web application server **122** or web application uses the web service API to send and receive messages between the micro blogging service and the web application server or web application. The web application server provides a configuration web page for the user to select micro bloggers and/or automated information postings such as weather and stock information that will then be automatically sent from the micro blogging server to the web application server which implements the micro blogging service API to send and receive messages. The messages are then transmitted to the internet information display device through wireless internet product system **100**.

In one embodiment, web application server **122** queries the user's email system using the account information provided by the user on the internet device configuration web page. The web application then collects email subject, sender, and partial first email body text from the user's email service and sends this information to the internet information display device to be displayed. The advantage of using the internet device for this purpose as opposed to a full email client is that the user only needs to look briefly at this device to determine if an important email has arrived and he needs to start his computer to deal with it.

In one embodiment, the internet display device web application server **122** takes information feeds such as an really simple syndication (RSS) feed and/or updates on friends' pages on a social networking site, sends this information through internet product system **100**, and displays the news feed information on the LCD display.

The next of these various embodiments of the invention is the embodiment where one or more internet product **102** is an animatronic toy such as a toy robot, animatronic character, or animatronic pet such as a dog, cat, or other animal. The animatronic toy has motor controls to move or gesture and may also have the ability to make sounds or play sound files. Some of these toys will have the ability to play sound files such as stories and coordinate animatronic movements to create the illusion that the animatronic toy is a talking, as the toy moves and changes expression though animatronic movements of eyes, mouth, eye brows, ears, head, tail, hands and/or feet. The animatronic toy is an one or more internet product **102**, has the radio previously described above, and is connected to wireless internet product system **100**.

A web application hosted on the web application server **122** for the animatronic toy is created that has the following features. The web application has a depiction of the animatronic toy which, in this embodiment, is built using FLASH®. When the user interacts with the FLASH® depiction, command signals are sent to the animatronic toy which cause movement, actions, and sounds in response to actions taken by the user on the web application. As an example, the animatronic toy can be remotely controlled by the user by dragging its hands and feet with the mouse, which triggers physical movement of the hands and feet, and other items in the animatronic toy.

There are also sensors for sound, light, and position for the animatronics that allow activity or movement of the animatronic toy to be sensed and transmitted through the wireless internet product system **100** to the web application and trigger changes in the depiction of the animatronic toy on the web page.

Similarly, web games can be played where, during the game, signals are sent to and received from the animatronic toy to provide information to the web game and affect the web game outcome. In this way the animatronic toy becomes an input and output device for the web game. In one embodiment, the animatronic toy can be used to interact with online virtual words. For example, success in the activities and games in an online world leads to signals being sent down to the animatronic toy to unlock new capabilities such as the animatronic toy being able to be used to detect a sound in your room, sound an alarm, and sent a signal that will be recorded by the web application.

In one embodiment, the animatronic toy senses that it is being played with through accelerometer sensors, motion sensors, sound sensors, and proximity sensors, and sends this activity information to the web game or virtual world, where the user is rewarded for the play time with online bonuses. Bonus can be used as online currency to purchase virtual items, virtual real-estate, or abilities in the virtual world.

In one embodiment, data from the motion sensors of one animatronic toy can be sent through internet product system **100** to another animatronic toy. When a user moves the motor and sensor-enabled parts on the animatronic toy, another animatronic toy linked to the first toy moves to mimic the positions of the first toy. Both animatronics toys need only be connected to internet product system **100**. They can be controlled over distance this way with one toy being the controller and the second toy being controlled by the movements of the first toy.

The next of these various embodiments of the invention is the embodiment where one or more internet product **102** is a handheld or table-top game such as an electronic version of a game TV show, chess, checkers, poker, blackjack, craps or other such games. The game is an internet product **100** and therefore includes the radio system described above and is connected to the wireless internet product system **100** described above. The game allows the user to connect to one or more users with compatible devices or compatible web applications on web browsers to play a game. The user can select an unknown player of a similar skill level as computed by win/lose record, or may select a friend's screen name to indicate what opponent she would like to play against. The game internet product system is also connected to a game web application that provides a way for users to play games with other users though any web browser since the web application provides a JAVA® or FLASH® representation of the game that send the same movement and commands as the internet product game and therefore any combination of web browser or internet product players may play each other.

In one embodiment, when the user creates a high score on the game the high score is transmitted to all game devices or a subset of the game devices connected to wireless internet product system **100** so that all users will see the name or initials of a new top player along with the player's high score.

In one embodiment new game play content such as questions, topical trivia, sports statistics and other fresh content are downloaded to the games through wireless internet product system **100**.

For all the above applications, content can be downloaded from web application server **122** to one or more internet product **102** without requiring any intervention from the user as the low power radio subsystem can remain on and always connected and therefore always ready to receive new content even when the internet product is in the off mode since this off mode does not turn off the radio subsystem. This always-on connection even when the internet product is nominally off is possible because of the low power requirements of the radio hardware and CRP protocols.

Foregoing descriptions of specific embodiments of the invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed. Modifications and variations are possible in light of the above teaching. For example, applicant contemplates that present invention may be applied for various purposes, such as economizing use and optimizing storage of fossil fuels or other non-fossil energy conservation, as well as bioinformatic/biohazard or other remote sensor application for homeland security and defense or anti-terrorist surveillance or control functions.

The embodiments were chosen and described in order to explain the principles and the application of the invention, thereby enabling others skilled in the art to utilize the invention in its various embodiments and modifications according to the particular purpose contemplated. The scope of the invention is intended to be defined by the claims appended hereto and their equivalents.

What is claims is:

1. A network communication system for communicating with software applications through a proxy server and a firewall, the network communication system comprising:

an electronic device to: (i) transfer a unique identifier (ID) through the firewall using a protocol; and (ii) transfer or receive data in one or more packets through the firewall using the protocol, wherein the unique ID corresponds to the electronic device, and wherein a packet length of the one or more packets as they are sent through the firewall is shorter than a web service protocol packet length having corresponding information content and is shorter than 65,507 bytes; and

a translation server being configured to route the data in the one or more packets between the electronic device and the software applications using the unique ID;

wherein the translation server is configured to translate the protocol to and from the web service protocol, the web service protocol being used to transmit the data in the one or more packets through an internet between the translator and the software applications;

wherein the software applications utilize web services to process the data in the one or more packets; and

wherein the electronic device communicates with the software applications using both the protocol and the web service protocol in combination.

2. The network communication system according to claim **1**, wherein the protocol is an internet message system (IMS) protocol.

3. The network communication system according to claim **1**, wherein the electronic device communicates wirelessly.

4. The network communication system according to claim **3**, wherein the electronic device communicates wirelessly using a compact radio protocol (CRP).

5. The network communication system according to claim **1**, wherein the electronic device is a gateway.

6. The network communication system according to claim **1**, wherein the electronic device includes a low power wireless circuit.

7. The network communication system according to claim **1**, wherein the electronic device further comprising an internet product that communicates over the internet.

8. The network communication system according to claim **1**, wherein the electronic device comprises a dongle configured to couple to a personal computer.

9. The network communication system according to claim **1**, further comprising a table entry including information enabling the router to cause the proxy server to transfer the data through the firewall.

10. The network communication system according to claim **9**, wherein the table entry includes a timeout time which is used to block the transfer.

11. The network communication system according to claim **1**, further comprising a state or key value pair message associated with the electronic device.

12. The network communication system according to claim **1**,

wherein the electronic device is selected from the group consisting of: a thermostat, an animatronic toy, a medical sensor, a touch screen a display drawing pad, and a sensor; and

wherein the electronic device is responsive to the data.

13. The network communication system according to claim **1**, further comprising a signal strength circuit being configured to detect a predetermined reduced signal strength condition which initiates a resynchronization scan.

14. A method for communicating with software applications through a proxy server and a firewall, the method comprising:

transferring, using a radio on an electronic device, a unique identifier (ID) through the firewall using a protocol, wherein the unique ID corresponds to the electronic device;

transferring or receiving, using the radio on the electronic device, data in one or more packets through the firewall using the protocol, wherein a packet length of the one or more packets as they are sent through the firewall is shorter than a web service protocol packet length having corresponding information content and is shorter than 65,507 bytes;

routing, using a processor on a translation server, the data in the one or more packets between the electronic device and the software applications using the unique ID; and

translating, using the processor on the translation server, the protocol to and from a web service protocol, the web service protocol being used to transmit the data in the one or more packets through an internet between the translator and the software applications;

wherein the software applications utilize web services to process the data in the one or more packets; and

wherein the electronic device communicates with the software applications using both the protocol and the web service protocol in combination.

15. The method according to claim **14**, wherein the protocol is an internet message system (IMS) protocol.

16. The method according to claim **14**, further comprising transferring the data received wirelessly from an internet product that communicates over the internet.

17. The method according to claim **16**, wherein the transferring transfers the data wirelessly using a compact radio protocol (CRP).

18. The method according to claim **14**, further comprising providing a state or key value pair message associated with the electronic device.

19. The method according to claim **14**, further comprising transferring data from an electronic device selected from the group consisting of: a thermostat, an animatronic toy, a medical sensor, a touch screen display drawing pad, and a sensor; and

wherein the electronic device is responsive to the data.

20. The method according to claim **14**, further comprising providing a table entry including information enabling the routing step to cause the proxy server to transfer the data through the firewall.

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